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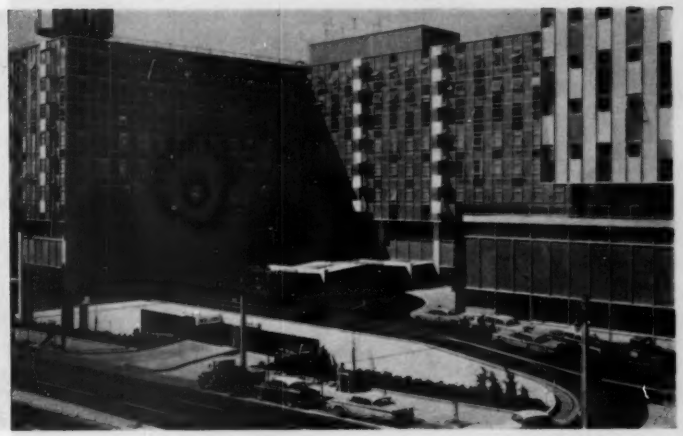
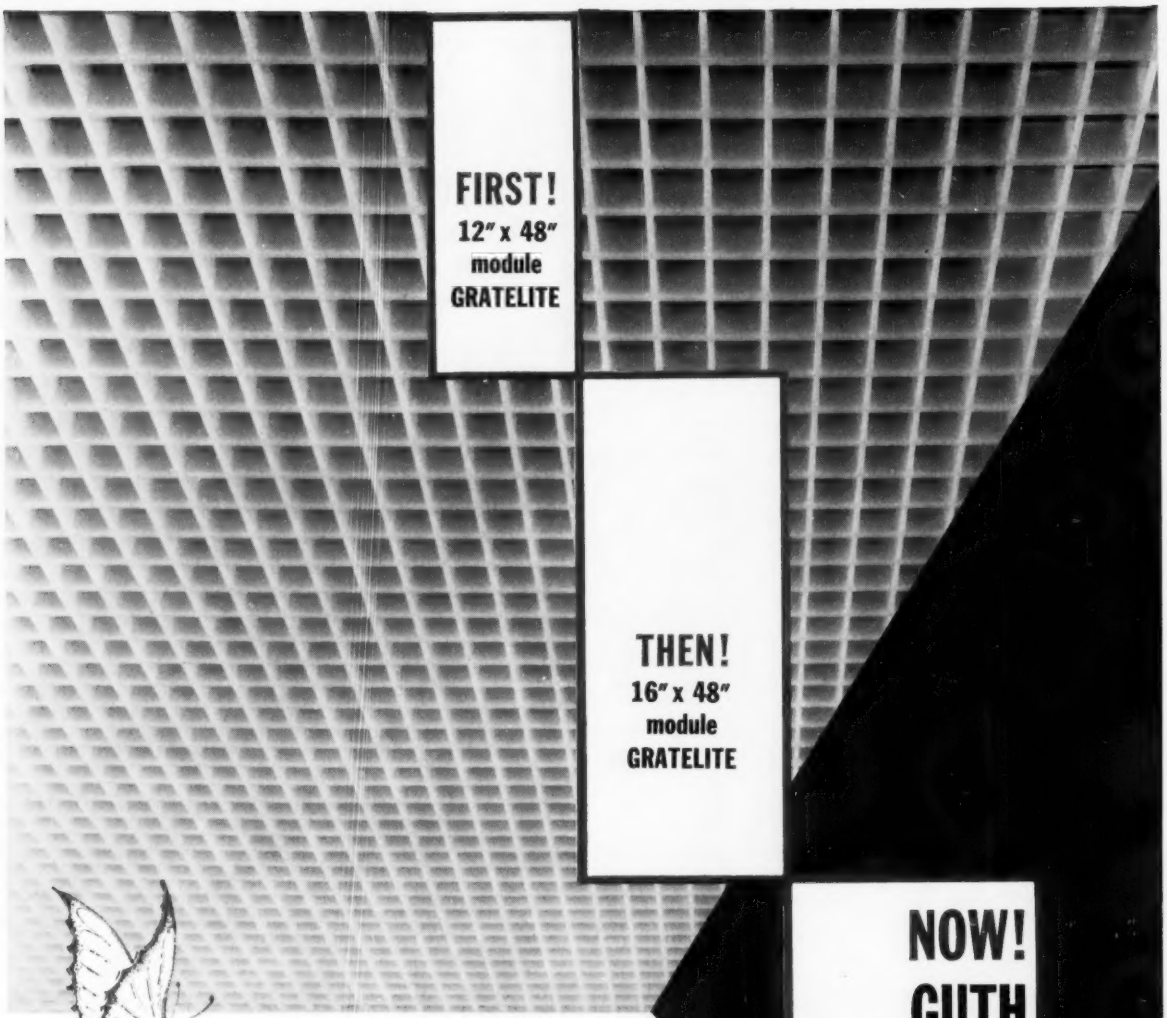
WIRING DINERS—a New Jersey electrical contractor wires prefabricated buildings at the plant.

SAN FRANCISCO'S NEW JACK TAR HOTEL—electrical system includes closed circuit TV and other special systems to speed service.



PRACTICAL SHOP METHODS—a roundup of practices in and around San Francisco—host city to 1961 EASA convention.

A McGRAW-HILL PUBLICATION | 60TH YEAR



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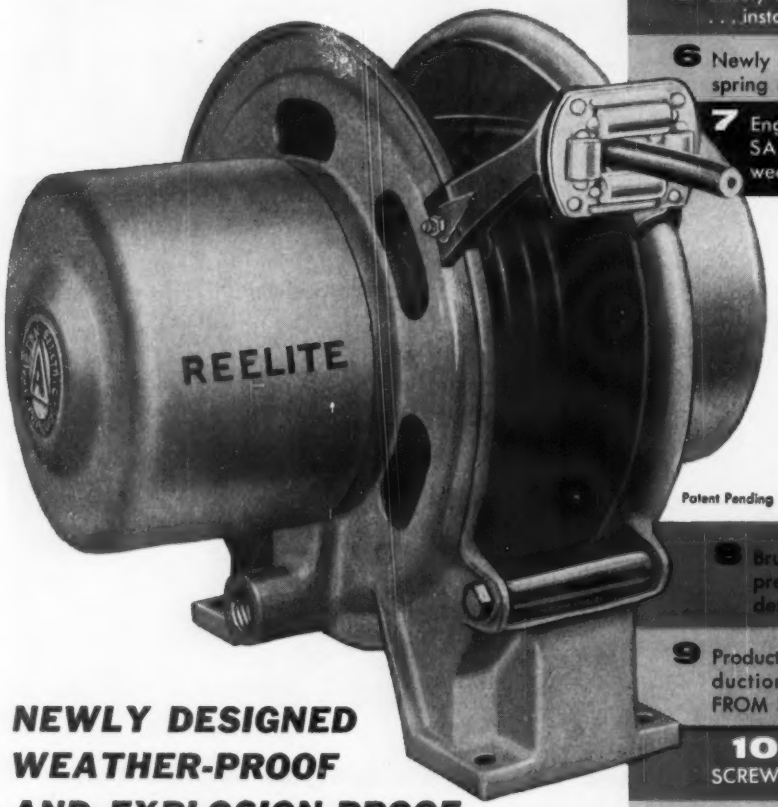

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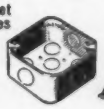
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MORE

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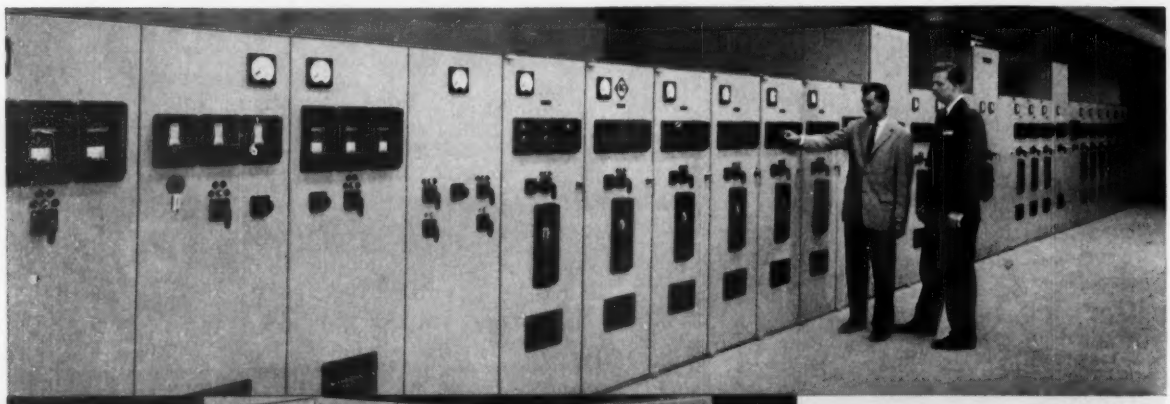

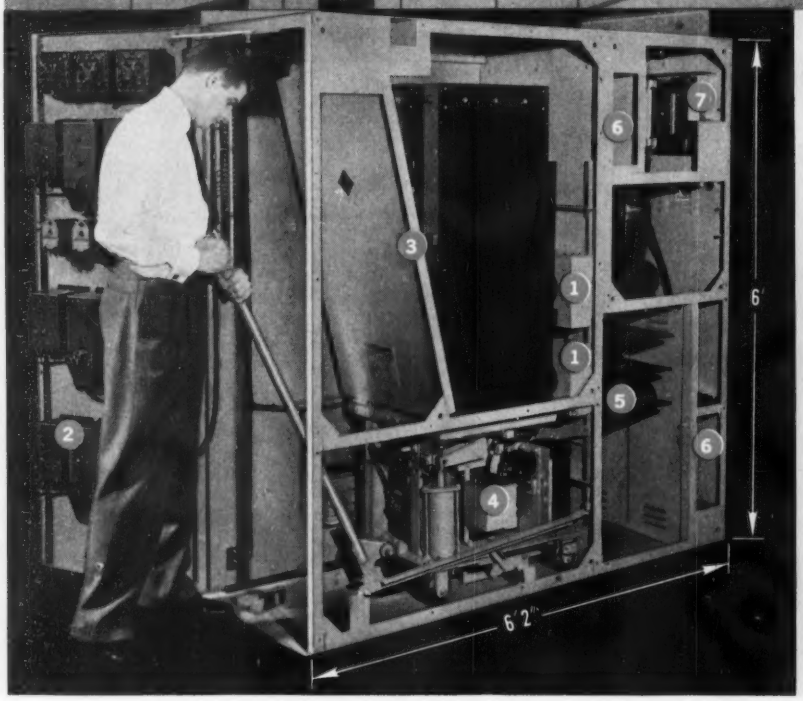

4.16 kv metal-clad equipment serving a west coast city.

1. Separate compartments for current transformers.
2. Full panel metering and relaying.
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4. Easy service accessibility without dismantling.
5. Glass polyester insulation throughout.
6. Separate up-feed and down-feed cable compartments.
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the only switchgear with fully isolated current transformers

The front-accessible current transformers can be inspected, maintained or replaced without exposure to any high voltage compartment. A-C metal-clad units are just 72 inches high — means eye-level instrumentation . . . shoulder-height accessibility of component parts. And the entire panel can be used for meters and relays. Maximum compartmentation and dead-front construction offer greater safety. Buswork and components arranged for easy addition of future units.

You get rapid, one-stroke insertion of the circuit breaker. The breaker has glass polyester insulation for highest impulse strength . . . the only self-locking protective barrier . . . four-bar linkage is mechanically, electrically trip-free. Primary disconnect fingers eliminate use of garter springs, and are on the circuit breaker for easy inspection. Both stored energy and solenoid operators are available. *For more switchgear information contact your nearby* **Allis-Chalmers** *office.* A-1457

Sidelights

SPECIFICATIONS

Coming next month, the editors present the 7th revision of "Electrical Specifications." The project is a comprehensive prototype master electrical specification for the installation of electrical systems in buildings. Designed to provide a thorough check list, a guide to specification writing and typical specification paragraphs in each major category of electrical work, it is an immediately useful aid for the preparation of job specifications, descriptions or work orders.

EASA

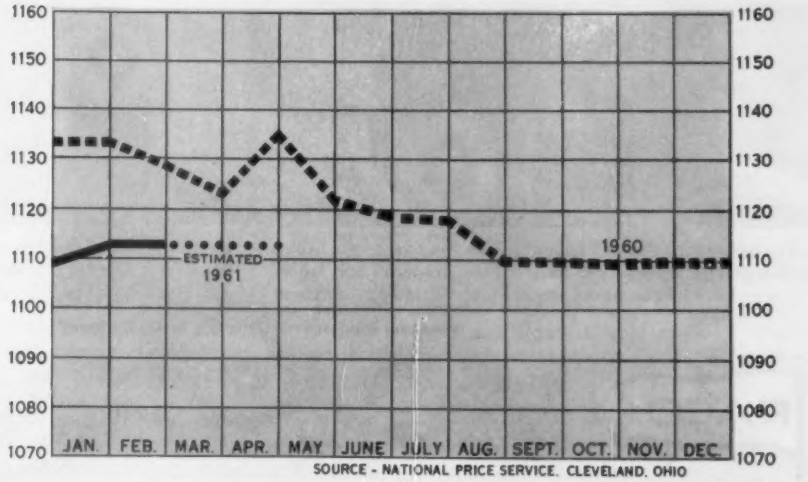
The National Industrial Service Association (NISA), organization of electric motor service establishments, formally adopts its new name, Electrical Apparatus Service Association (EASA) this year. The 28th annual convention will be held in San Francisco, at the new Jack Tar Hotel on June 11-14. Many San Francisco shops will extend open house hospitality to the delegates from throughout the U. S. As a preview, Associate Editor Hugh P. Scott has prepared a roundup of local practical methods and equipment. The report "San Francisco Shop Practices" begins on page 83. The convention site is of unusual interest to electrical men. Facilities include TV communication and many other special electrical systems to speed service and convenience to guests. See "Electrical System Features of Jack Tar Hotel" beginning on page 90.

PREFAB WIRING

Modern highway diners are marvels of completely pre-fabricated construction. Built in sections for transportation by trailer, they are quickly assembled on the site, ready for the connection of services. All electrical work including panelboards is completed in the plant, ready for the installation of service entrance and feeders to each section at the site. How are the electrical systems installed? John Denardo, electrical contractor of Maplewood, N. J., takes over in the plant of the Fodero Dining Car Company in Bloomfield, N. J. There the electrical system is installed with meticulous workmanship and care. The work is then inspected by an electrical inspector for conformity not only to the NEC but to any special rules applying at the site where the building will be located. Associate Editor J. F. McPartland describes this unusual specialty in "Packaged Wiring for Diners" beginning on page 94.

ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



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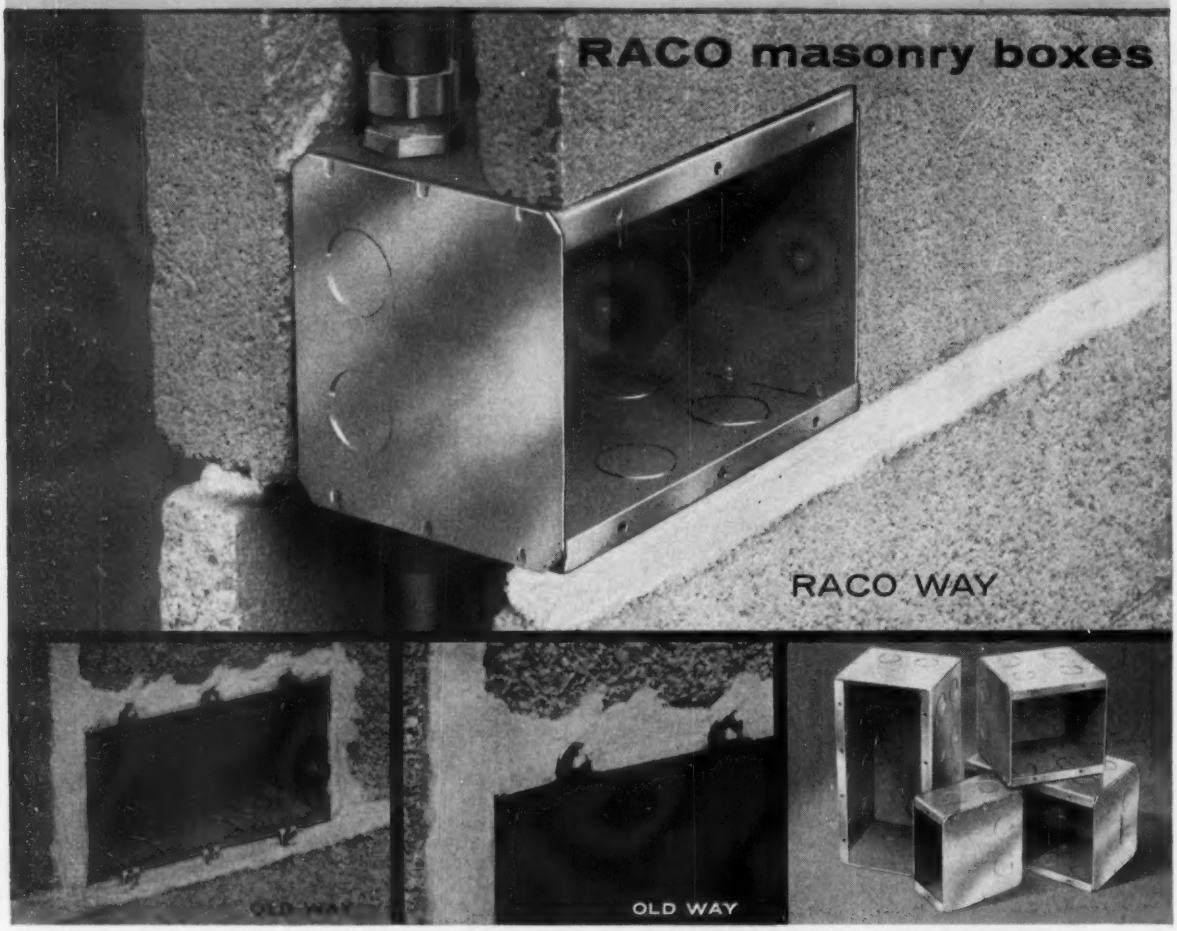
do a better job...save time and money

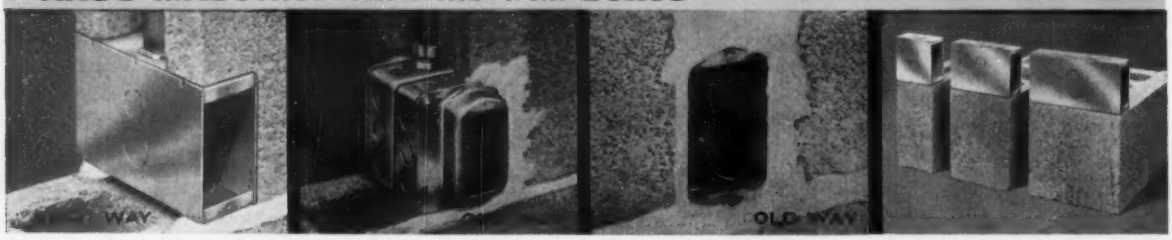


Raco masonry boxes have a "sheer" rectangular design saving installation time—no ears to cut around.

Raco boxes are deep—conduit fits the voids of the block perfectly. Device holes are on the inside of Raco boxes—eliminating re-tapping and reducing "mudding around".

Available in 2, 3, or 4 gang boxes; 2½" or 3½" depths, with ½" or ¾" knockouts. Whatever the job, Raco has a time-saving masonry box to fit the need.

RACO MASONRY Thru-the-wall Boxes



Raco masonry thru-the-wall boxes replace two boxes, one fitting and two plaster covers—you save money, material and labor. Square cornered Raco boxes require less "mudding" and less time to install. Available in three sizes—for use with 4", 6" or 8" cement blocks. You save time and money, do a better job, with Raco masonry through-the-wall boxes.

Send for the Raco masonry box brochure today.

RACO

ALL-STEEL EQUIPMENT INC., Aurora, Illinois

Washington Report

APRIL • 1961

The recession has bottomed out, but there are no signs of a sharp upturn, in the opinion of most Federal economists and government officials. There are no signs pointing to strong recovery in housing, autos, and steel. Current gains are considered largely seasonal. High unemployment persists, and unemployment of 7% or more of the total labor force is predicted by labor economists by next January. Thus liberals pressure Kennedy to combat unemployment through heavy deficit spending, principally on big public works projects.

Commerce Secretary Hodges cited the February increase in retail sales of 1% above January as a possible beginning of a business upturn. Walter Heller, chairman of President Kennedy's Council of Economic Advisers, advised late in March that a business upturn is "in sight," but cautioned that it will be a slow one. President Kennedy also acknowledged in late March that there is evidence of some economic improvement, but said the question was whether the upturn would be adquate to reduce current unemployment and to begin a sustained economic growth.

Building construction is on the rise, and may well be a major factor in putting new life and growth into the economy. The current activity is in heavy construction, however, and not in homebuilding, as has been the case in economic recoveries from previous recessions.

Construction put in place in the first two months of this year totaled $4.5 billion, not including residential and farm building. This is 12.5% more than for the same period of 1960. Privately financed construction, at $2.5 billion, was up 8.7% from last year, and publicly financed work totaled $2.0 billion, up 17.6%. The increases are in commercial, industrial and government buildings, and in roads and public and private facilities such as generating stations and missile bases. Road building contracts are up 43% over same period of last year, and an estimated $7 billion will be spent on roads this year.

Private homebuilding in January was down 12% from January 1960, in dollar volume, or $1,432 million compared with $1,620 million a year earlier. Starts this January were 72,000, compared with 85,500 last year. However, both government forecasters and homebuilders are optimistic that 1961 homebuilding will improve over 1960's 1,240,000 units, with the upswing occurring during the second half of this year.

Here's a roundup of factors which influence the outlook:

- **Gross National Product** in 4th quarter of 1960 was $503.5 billion, but $17 billion over 1959 4th quarter.
- **Personal income** in January was $406.3 billion, down $0.5 billion from Dec. 1960, but $10.5 billion over Jan. 1960.
- **Total employment** in February was 64.7 million, up 200,000 from January, and up 200,000 from February 1960. Unemployment also rose to 5,700,000 in February.
- **Cost-of-Living** dropped 0.1% in January from the December index of 127.5% (of the 1947-49 average), first time it has declined since January 1960.
- **Installment credit** outstanding dropped in Jan. to $42.8 billion, for a decline of $103 million, first drop since Sept. 1958.
- **Industrial production** in February remained at 102% (of 1957 average), same as January, ending a month-to-month decline over the past six months.

Telephone man Robert Dahill checks position of telephone-wired kitchen outlet with builder Arthur P. Aaron.

Breezeways of A & A homes come with outlets for permanent or portable telephones.

Your Telephone Business Office will gladly help you telephone-plan your homes. For details on home telephone installations, see Sweet's Light Construction File, 11c/Be. For commercial installations, Sweet's Architectural File, 34a/Be.

"We're always looking for something that will help sell houses, and concealed telephone wiring does"

SAYS ARTHUR P. AARON, A & A BUILDERS, INC., AVON, CONNECTICUT

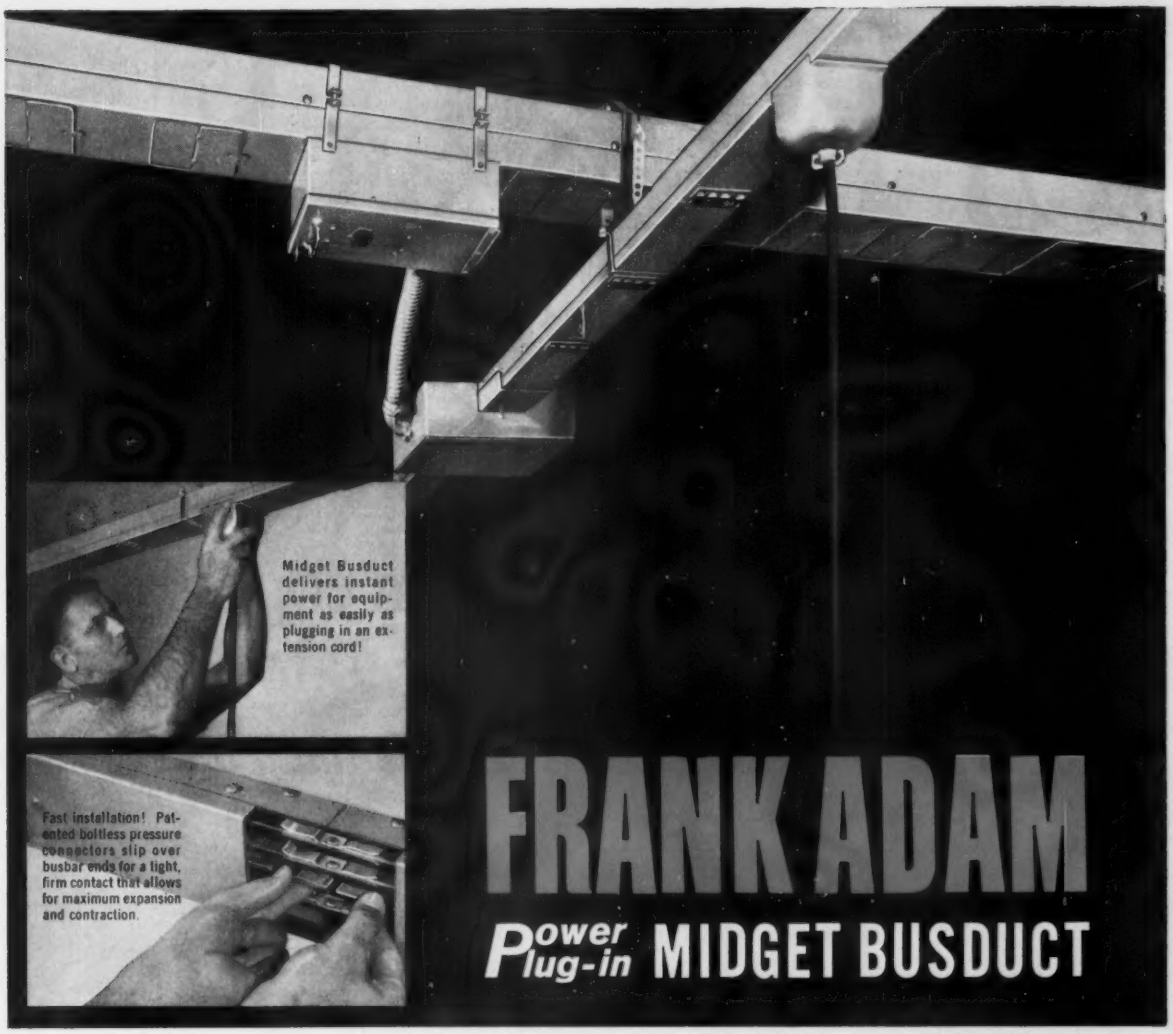
Arthur P. Aaron was the first contractor in Connecticut to telephone-plan his homes with concealed telephone wiring. "For the nominal cost, concealed wiring is definitely a good investment," says Mr. Aaron. "We're always looking for something that will help sell homes, and concealed wiring does just that."

Mr. Aaron has constructed homes from $20,000 to $35,000, all with concealed telephone wiring. He's also planning to pre-wire homes of $15,000 and $16,000 which he expects to build in Avon and Norwich this year.

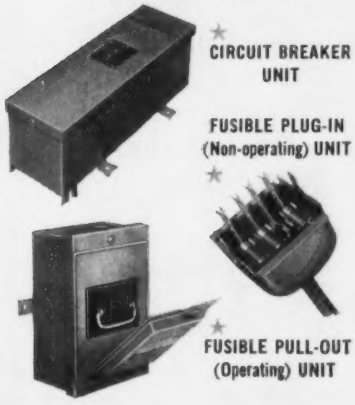
"I mention concealed telephone wiring in my newspaper advertising, and I instruct my salespeople to point out this feature in our model homes," says Mr. Aaron. "It's an extra selling point, it's practical, and the other fellow may not have it."

BELL TELEPHONE SYSTEM

EXTEND ANY PRESENT BUSDUCT SYSTEM TO ANY SPOT IN THE PLANT FOR LESS THAN THE COST OF WIRE & CABLE!


Midget Busduct delivers instant power for equipment as easily as plugging in an extension cord!
Fast installation! Patented boltless pressure connectors slip over busbar ends for a tight, firm contact that allows for maximum expansion and contraction.
FRANK ADAM
Power Plug-in MIDGET BUSDUCT

CHOOSE FROM THREE TYPES OF PLUG-IN UNITS



100-Amp. plug-in power fed from existing busduct to any location with MIDGET BUSDUCT

Although the initial price of Midget Busduct is slightly more than wire and cable, the saving on labor alone results in a surprisingly lower installed cost.

No cutting or bending, no threading of conduit is necessary with Midget Busduct. It is 100% salvageable when plant layouts are changed, or machine relocations are made. Quick availability of plug-in units permits load connections in minutes to save even more on labor.

Either copper or aluminum conductors can be furnished. Midget Busduct has plug-in outlets every 10", on one or both sides, to accommodate three types of plug-in units, shown at left, in 30 to 100 amp. capacity. *Ask for complete information and prices.*

FRANK ADAM ELECTRIC COMPANY
SINCE 1891
P. O. BOX 357, MAIN P. O. · ST. LOUIS 66, MO.

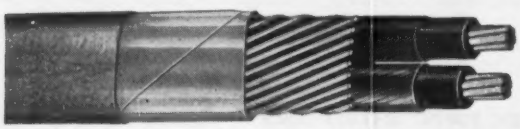
KEEP PACE WITH ELECTRICITY

busduct · panelboards · switchboards · service equipment · safely switches · load centers · Quikheter

MAKE THE CHANGE AND COUNT YOUR SAVINGS

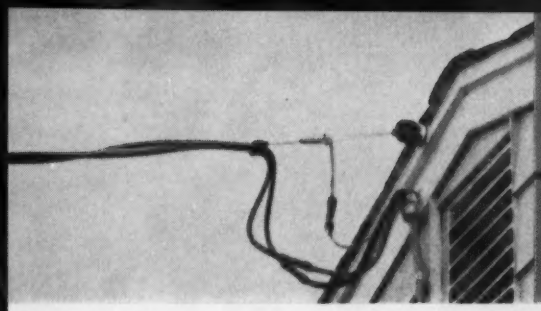
See how the switch from copper to Rome's *aluminum* service entrance cable can improve your competitive position.

It's a fact: Aluminum service entrance cable usually costs less than copper cable required to do the same job. Just how much less depends on service, size and the amount of each kind of cable you use. Check the tables on the right and compare the difference between the cost of copper and the equivalent in Rome's aluminum service entrance cable. Then multiply the difference by your requirements. There's your saving—and no question about it. And don't forget that aluminum's light weight makes it easy to handle. The weight it saves is weight you'll *never* have to heft, load, unload and carry to an installation site! The savings in dollars and ease of installation speak for themselves. If you'd like the complete story on performance, availability and installation, contact your nearby Rome distributor or sales representative. Rome Cable, Division of Alcoa, Dept. 7-41. Rome, New York.



ALUMINUM service entrance cable from the Rome Cable Division of Alcoa is available in two- or three-conductor types, insulated with Underwriters-approved heat- and moisture-resistant compound. The insulated conductors are enclosed in a color-coded protective tape. The concentric conductor consists of a spirally applied conductor having a circular mil area equivalent to the AWG size specified for the neutral conductor.

ALCOA
ROME CABLE
DIVISION



ROME SERVICE ENTRANCE CABLE

THREE CONDUCTOR • TYPE "SE" • STYLE "U"

Underwriters Approved

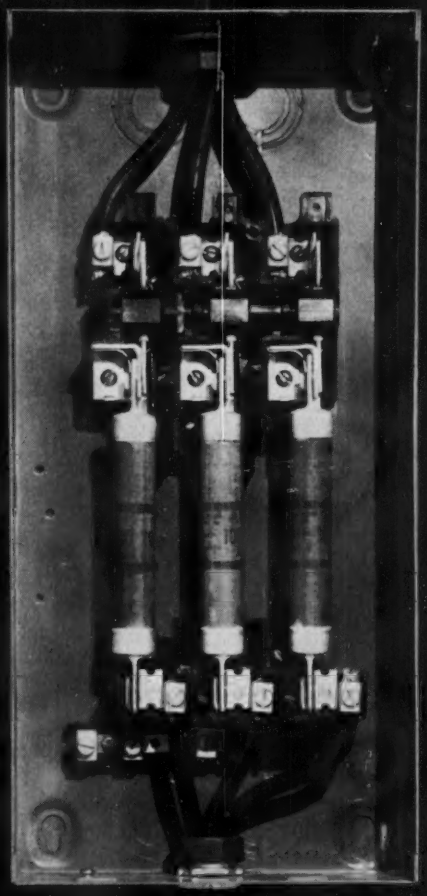
COPPER			ALUMINUM			SAVINGS	
CIRCUIT RATING IN AMPS	INSULATED CONDUCTOR SIZE AWG	LIST PRICE PER 1000 FT.	CIRCUIT RATING IN AMPS	INSULATED CONDUCTOR SIZE AWG	LIST PRICE PER 1000 FT.	DOLLARS	PERCENTAGE (Approx.)
60	6	241	60	4	235	6	2%
100	3	407	100	2	303	104	26%
125	1	784	125	1/0	472	312	40%
150	1/0	947	150	2/0	520	427	45%
200	3/0	1390	200	4/0	704	686	49%

The powder-actuated tool shown here is a fundamental improvement over other methods of fastening to steel and concrete. Five years of extensive field experience have demonstrated that its fastenings are at least the equal of those made any other way. But it will make them faster, more economically, and with less effort required from your work force. It's called the Duo-Jobmaster and it's part of the Ramset Fastening System.

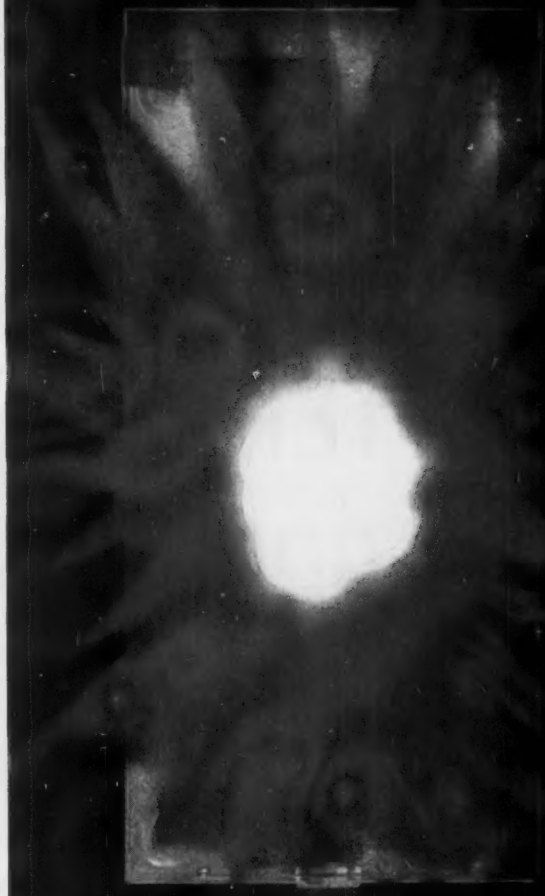
For immediate service, call your local Ramset dealer. He's listed under "Tools" in the Yellow Pages. For information write to: ***Ramset Fastening System***

WINCHESTER-WESTERN DIVISION Olin

285D Winchester Ave., New Haven 4, Conn.



CLF* FUSE



CONVENTIONAL FUSE

40,000 amp test proves **CLF*** fuse protects—Conventional fuse fails

SAFETY you can see!

The explosion of a fuse box from a severe short-circuit, such as 40,000 amps, can be highly dangerous to costly equipment and to personnel maintaining it. As your power system expands, your short-circuit level may exceed the safe interrupting capacity of conventional fuses, causing such an explosion.

General Electric's new Class J, Class H and Class L CLF fuses are laboratory-tested to supply an interrupting capacity of 200,000 amps, providing safe protection when you need it most. The maximum current passing through a CLF fuse is limited by specially-designed silver elements.

The 40,000 amp test above illustrates the risk of allowing conventional fuses to protect your electrical power system. Elements in many conventional fuses allow the short-circuit level to reach a point which can touch off a damaging explosion. With today's costly equipment, conventional fusing is a risk you can't afford.

As your power system expands, specify General Electric CLF fuses . . . specify safety you can see! For further information, write section 618-01, General Electric Co., Schenectady 5, N. Y.

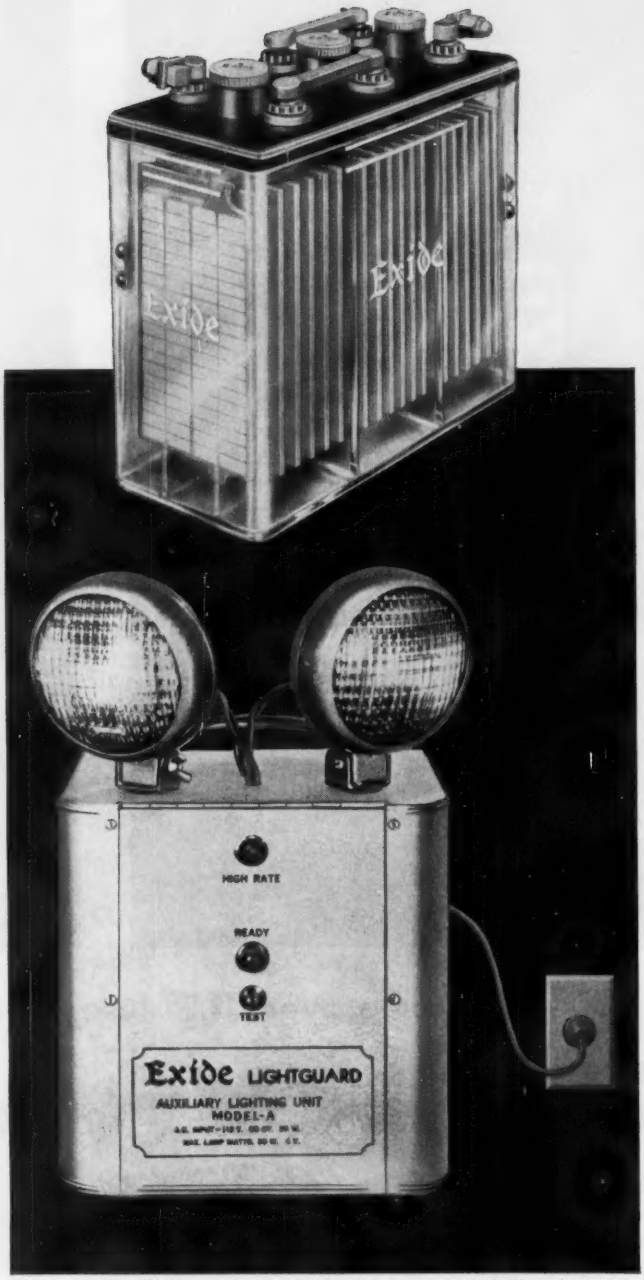
*CLF is the trademark of the General Electric Co., for high interrupting capacity fuse which meets new NEMA standards FU 1-1959.

Progress Is Our Most Important Product

GENERAL ELECTRIC

YOU NEED A GOOD BATTERY FOR GOOD LIGHT

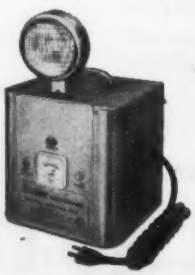
Only Exide Lightguard® emergency lighting units have genuine Exide storage batteries. Extra capacity and extra life are built in. When your regular power fails and Exide Lightguard goes on, you're assured of extra hours of strong light. And you can go for a good many years without battery replacement expense. Exide Lightguard is completely automatic. Goes on when lights go out. Built-in charger automatically brings battery back to capacity after each time used and keeps it there. Easy to install. Just plug into regular a-c outlet. Ask about it at your nearby electrical distributor's. Or write for literature. Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.



When regular lights go out, Lightguard goes on . . . instantly and automatically. This is Model A, the most popular model. Available for one, two or three lamps.

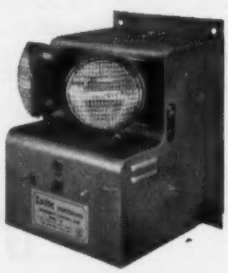
Exide®

INDUSTRIAL MARKETING DIVISION
The Electric Storage Battery Company ESB



◀ **Dry cell model**
Most economical to buy. Same lamp brilliance as storage battery model. Uses standard dry cells.

To cover large areas ▶
New Model E. Three times the battery capacity. Can handle up to five lamps.



ENLARGED AND EXPANDED!

GraybaR's #3 IDEA BOOK

- More than 50 ways to save time and money!
- Must reading for contractors, utility men, maintenance people, purchasing agents!

Eliminate Welding with easy-to-use UNI-SEAL RIGID CONDUIT HUB

The Uni-Seal Rigid Conduit Hub does away with expensive, unreliable, time-consuming welding. A 360°, uniformly centered, "cold-weld", metal-to-metal seal does the job everytime. A patented wedge adapter pulls up tightly in the knock-out hole when the threaded hub is screwed down. The rigid-conduit hub bites into the outer box wall metal to eliminate loosening through vibration, assuring a perfect ground.

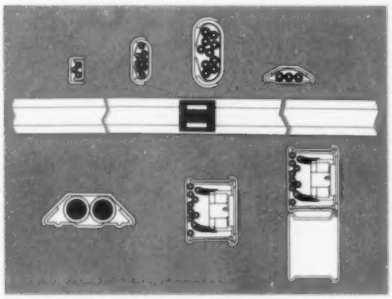
Features of the Uni-Seal Rigid Conduit Hub include:

- **LIQUID TIGHT.** Special internal "O" ring construction keeps out foreign matter.
- **NEW INSULATED THROAT.** No sharp edges; full throat diameter.
- **INCREASED WIRING ROOM.** New virtually flush wedge adapter allows more wiring space.
- **NEW LOCKING EDGE.** Conduit hub bites into outer box wall; eliminates locknut.
- **NEW WEDGE ADAPTER.** Constant liquid-tight seal assures perfect ground.
- **MEETS UL AND JIC STANDARDS.**

For complete specifications and literature on the Uni-Seal Hub, simply circle number 1 on the Graybar postcard.

APPLETON ELECTRIC COMPANY

NATIONAL ELECTRIC makes SURFACE WIRING easy to install, easy on the eyes, easy on cost



Metal molding, Surfaceduct, Twinduct, Florduct, Plug-in Strip . . . National Electric makes them all. And now you can order from Graybar. Compare . . .

Installation. NE base-and-cap construction makes it fast and easy. Just fasten the base, lay in the wires and snap on the cap. No fishing. Fewer fittings. All types interconnect.

Looks. Minimum cross section, since there's no fishing space required. Low contour makes good appearance.

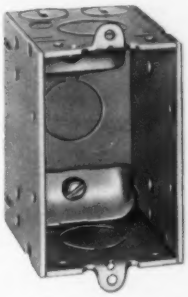
Cost. Fast installation . . . saves money on every job. Fewer fittings to buy.

For more information, circle number 2 on the Graybar postcard.

NATIONAL ELECTRIC DIVISION
H. K. PORTER COMPANY, INC.

NEW!

STEEL CITY Non-Gangable SWITCH BOXES



For Armored and Non-Metallic Sheathed Cables

Features:

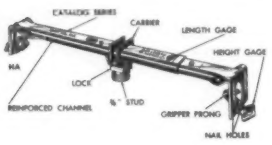
- Square Corners
- Welded Construction
- Flat Sides
- Clamps: C-3 Armored; C-5 Non-Metallic
- ½" K.O. in bottom
- ½" K.O. and Priouts in each end
- Electrogalvanized

Available with "S" Bracket, 16d Nails-staked, "V" Bracket, and 2-Screw Ears. Circle number 3 on the Graybar postcard for more details.

STEEL CITY ELECTRIC COMPANY

For more information on any

EFCOR New Adjustable Bar Hanger Eliminates stud disassembly!



The new EFCOR Adjustable Bar assembles to switch and outlet boxes as easy as 1-2-3, without stud disassembly. All you do is insert the stud that is preassembled to the bar through the knockout, then tighten the fastening screw. That's it! This simple operation locks the box in place automatically.

The Adjustable Bar is provided with either ⅜" stud or no-stud clip. Size can be adjusted from 11½" to 18½" and from 16½" to 26½". Other "extras" include reversible stud or clip, new patented gripper prongs, pre-set length gage, height-positioning gage, friction slide, uniquely designed reinforced channel for greater strength and rigidity.

We'll send more information if you'll circle number 4 on the Graybar postcard.

ELECTRICAL FITTINGS CORP.

Feed machine tools without rigid conduit...with PWC Bus Drop Cable

Now you can provide flexible branch circuit runs between overhead bus feeders and electrically powered machine tools and equipment, with PWC Bus Drop Cables. Especially valuable for machine shops that must align machinery to fit varied production jobs. May be installed from a bus attachment or feeder raceway to the machine control box; standard fittings may be used. PWC Cable is highly resistant to damage by lubricants, cooling oils, impact and abrasion. Available in sizes from #14 to #2 AWG, with three insulated conductors and three grounding conductors.

For data sheets giving full description of PWC Bus Drop Cable (sizes, diameters, stranding, etc.) and accessories, simply circle number 5 on the Graybar postcard.

PLASTIC WIRE & CABLE CORPORATION

NEW from BERNZ-O-MATIC! Double-value Carry-all Torch Kit

Here's a complete BERNZ-O-MATIC Torch Kit with metal carrying case and attachments for doing hundreds of maintenance, repair and construction jobs! Comes complete in a metal enameled carrying case, with plenty of storage space to add additional tools, plus solder, flux, etc. Lets you do jobs easier and faster, while saving time and money!

For information on the complete line of Bernz-O-Matic equipment, send in the handy Graybar postcard. Circle number 6.

OTTO BERNZ CO., INC.

KAISER Master LAYTEX® Portable Cords outlast other cords 3 to 1!

More than 12,000 tests, in the laboratory and in rugged plant installations, show Kaiser Master Laytex Cords give you these key advantages:

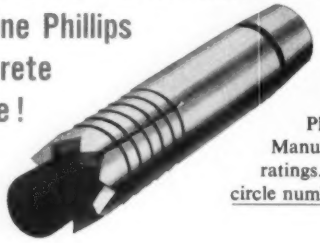
- 33% greater heat resistance
- 197% greater impact resistance
- 58% greater abrasion resistance
- 50% greater resistance to cutting
- 118% greater resistance to tearing
- 38% greater breaking strength
- 26% greater oil resistance
- 488% greater resistance to flexing

In short, Kaiser Master Laytex Portable Cords give you longer life than even a hypothetical cord combining the best features of all cords tested! Cords are available in 600-volt, heavy duty, Number 18 through 10 sizes; 300-volts, light-duty, Number 18 and Number 16 sizes. Conform to all industry practices concerning jacket thickness and overall diameter. Listed and labeled by Underwriters' Laboratories, Inc.

Our free 24-page booklet gives you all the information you need to choose the right cord every time. Simply circle number 7 on the Graybar postcard.

KAISER ALUMINUM & CHEMICAL SALES, INC.

CUT ELECTRICAL CONSTRUCTION AND MAINTENANCE MAN HOURS with the Original and Genuine Phillips RED HEAD self-drilling Concrete Anchor...drills its own hole!



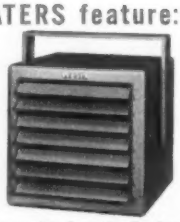
Fast, easy, most effective way to anchor conduit, junction boxes, cable trays, and any other electric power equipment to concrete. Makes conventional methods obsolete.

Phillips is the ONLY self-drilling Concrete Anchor Manufacturer to publish Pittsburgh Test Laboratory load ratings. Complete literature is available upon request. Simply circle number 8 on the Graybar postcard.

PHILLIPS DRILL COMPANY

WESIX CU AXIAL-FLOW HEATERS feature:

- Highest quality materials
- Over-temperature protection
- "Dust free" longitudinal fin enclosed type elements.



The WESIX CU Axial-Flow Unit Heaters are indicated for shops, factories, garages, playrooms . . . wherever larger areas require heat. Available 3,000 to 36,000 watts in all standard commercial voltages with or without built-in contactors.

Send for our free catalog and other literature for complete specifications on all models. Simply circle number 9 on the Graybar postcard.

WESIX ELECTRIC HEATER CO.

Jefferson DRI-LOK Fluorescent Ballasts

No more ballast compound leakage! Jefferson Dri-Lok Ballasts replace conventional compound with a new thermo-setting material that cannot liquefy—fills entire case, permanently bonds case, core and coil into one solid unit. Cooler, quieter, long-lasting operation. Dri-Lok Ballast is engineered to meet CBM higher light output standards.

For free literature showing the complete line, electrical specifications, etc., circle number 10 on the Graybar postcard.

JEFFERSON ELECTRIC COMPANY

item... mail card to GraybaR!

THOR UE-100 ELECTRIC HAMMER

the ONE tool that does all the work!

The THOR UE-100 Electric Hammer is made for dozens of jobs . . . from "star" drilling to knocking out a brick wall, from driving expansion plugs to notching heavy timber. It can be used for construction, maintenance, installation, renovation. Weight: 14 pounds. Length: 13½". Easy handling and tremendous power save you hours and dollars! For more information on the complete line of Thor tools, circle number 11 on the Graybar postcard.

THOR POWER TOOL COMPANY

For every weatherproof requirement... BELL Deluxe Devices, Covers and Boxes!

For your weatherproof applications, specify Bell, with the patented Saf-T-Lok cover! Stays in open position when desired; easily snaps shut with slight finger pressure.

Bell switches and solid brass weatherproof covers are available from one to ten gangs in any combination of devices desired. Use with Bell aluminum boxes, one or two gang, 3 to 7 hubs, ½" or ¾" diameter. For complete catalog, circle number 12 on the Graybar postcard.

BELL ELECTRIC COMPANY

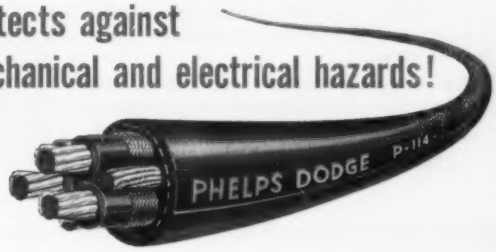
KEYSTONE WIREWAY SYSTEMS speed installation

Keystone quality wireways and fittings feature built-in extras that cut down installation time—eliminate wire damage! Extras such as a completely open "lay-in" design on the flangeless line . . . plus folded covers for added rigidity and interior screw tip shields—to install wires easily, and to keep them protected . . . permanently!

The entire ready-for-delivery Keystone line of wiring installation equipment is described in a new catalog. Free copies are available on request. Just circle number 13 on the Graybar postcard.

KEYSTONE MANUFACTURING COMPANY
DIVISION OF AVIS INDUSTRIAL CORPORATION

PHELPS DODGE Portable Cable protects against mechanical and electrical hazards!

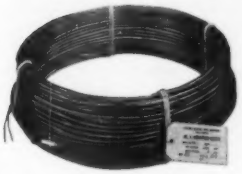


Years of Phelps Dodge "know-how" and manufacturing experience combine to give you the finest quality portable cable that you can specify. Use of this cable assures you the maximum in protection in locations which are subjected to mechanical and electrical hazards. Phelps Dodge Cables are listed by the U.S. Bureau of Mines, and approved by the Department of Mines, Commonwealth of Pennsylvania, P-114-BM.

For more information and specifications, get your free copy of our latest literature. Circle number 14 on the Graybar postcard.

PHELPS DODGE COPPER PRODUCTS CORP.

Need heavy-duty heating cable? Specify NELEX



For heavy-duty applications, rely on Nelex, the copper sheath mineral insulated heating unit, perfect for:

- De-icing concrete or asphalt
- Pipe tracing
- Temperatures to 480°F.

Our free descriptive brochure gives full information on sizes, voltages, and other specifications. You'll get a copy fast if you'll circle number 15 on the Graybar postcard.

NELSON ELECTRIC MFG. CO.

Add up the score! Y-ER-EAS proves best for Wire-Pulling Jobs!

1. OUTSTANDING SLIP QUALITIES make jobs easier, faster.
2. UNDERWRITER LABORATORIES APPROVED.
3. PACKAGED in convenient sizes.
4. OVER 35 years experience.
5. UL-APPROVED for conduit—aluminum, galvanized or steel.
6. CLEANEST wire pulling lubricant. Water soluble.
7. FACILITATES REMOVAL of cables. Never binds cable to conduit.
8. DRIES TO POWDER and leaves no sticky residue. Allows air to circulate through conduit.
9. STAYS PUT, will not run back into manholes, on panels or switchboard bus bars.
10. SAVES UP TO 20% in wire pulling costs.

It all adds up to the fact Y-ER-EAS is not outperformed by any others at any cost. We're prepared to fill your requirements immediately. Also . . . have you tried ALUM-N-EAS, the new thread lubricant for aluminum conduit?

For free literature, circle number 16 on the Graybar postcard.

ELECTRO COMPOUND CO.

Efficiency Type K non-adjustable Insulator Supports now PLATED at new low cost

The type K is designed for supporting porcelain and glass insulators to beams and angles in open steel construction of all kinds. Clamps tightly to the beam, requiring no burning or drilling holes.

Efficiency Supports are made of high quality cadmium-plated malleable iron. They are furnished with case-hardened, cup-point set-screws, as illustrated.

Available in the following four sizes for standard insulators: 1", 1½", 2", and 2½". For complete specifications on the entire line, simply circle number 17 on the Graybar postcard.

EFFICIENCY ELECTRIC AND MANUFACTURING CO.

NEW FLEXITITE SWITCH

- All-rubber push-button station
- Corrosion-proof, oiltight, watertight
- Oiltight construction at less than "Heavy Duty" prices
- Completely packaged, no separate parts to order
- Fits all FS and FD boxes—ONE STATION FOR ALL LOCATIONS

For more information on the complete line of Flexitite Push-button Stations, circle number 18 on the Graybar postcard.

JOY MANUFACTURING CO.
Electric Products Division

For more information on any

Get free sample and prove LEVITON gives *maximum performance* at *minimum cost!*

LEVITON wants you to try the new Leviton Flush Tumbler Switch—free! Millions in use everywhere . . . in every important project, for almost half a century, throughout the country and still servicing the original installation. See for yourself why you get no complaints, no call-backs with Leviton—and why Leviton devices are used by the millions!

Leviton provides a complete line of residential Wiring Devices for every installation requirement—standard screw terminal, Quickwire, T-Slotted, Parallel and Tandem Slotted, and U-Ground . . . as well as a wide selection of wall plates—everything required for residential use.

For 16-page catalog and your *free* tumbler switch (see it, take it apart and be convinced), circle number 19 on the Graybar postcard.

LEVITON MANUFACTURING COMPANY, INC.

REDUCE OUTDOOR LIGHTING COSTS

Four Conduit Pipe Sizes
H42200—2" H42250—2½"
H42300—3" H42400—4"

Base with 3-pole 110v receptacle cover

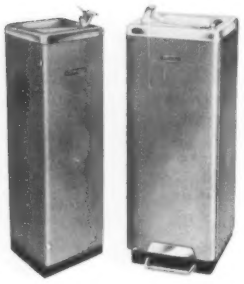
Base with two, 3-pole receptacle covers: 110v at front; 208v in back

© 1959

Specify the Original HOPE GALVANIZED MALLEABLE IRON POLE BASE

Attractive, rugged lighting poles easily fabricated by combining HOPE threaded Bases with standard galvanized conduit. Four Base sizes permit your fixture and elevation selection for a limitless variety of installations. Tapped deep for strong, locking engagement with pipe thread. Ample chamber for conduit stubs, splicing, grounding. For complete Bulletin G-25, circle number 20 on the Graybar postcard.

HOPE ELECTRICAL PRODUCTS CO.



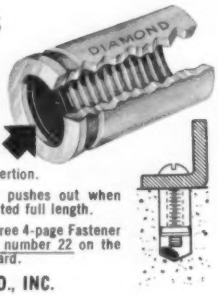
CORDLEY'S give you Good Looks plus Stamina!

Usually it's one or the other. But Cordley's have both! That's why Cordley supplies a brand new cooler under its unique 5-year replacement guaranty. No other cooler is guaranteed to this extent.

The big 1961 Cordley line has 31 models in bubbler and bottle types . . . a model for every drinking water need, including models that conceal plumbing, and Hot and Cold models with or without refrigerator compartment. For your free copy of Form 6P61, new cooler selector guide and catalog of this outstanding line, circle number 21 on the Graybar postcard.

CORDLEY & HAYES

5 New Additional Sizes DIAMOND RED SEAL® CALKING ANCHORS



Extra Value • No Extra Cost

Quicker, more effective installations with "Red Seal". Now available in the following sizes: 10-24, ¼"-20, ⅝"-12, ⅜"-16, ½"-13, ⅝"-11, ¾"-10.

• RED SEAL keeps dust and dirt from threads.

• RED SEAL gives quick identification for correct insertion.

• RED SEAL pushes out when screw is inserted full length.

Send for our free 4-page Fastener Guide! Circle number 22 on the Graybar postcard.

DIAMOND EXPANSION BOLT CO., INC.

INTERMATIC Time Controls for faster installation and greater reliability!

For reliable Time Controls, specify INTERMATIC, the unit that gives you all these time and money-saving features:

- 40-Amp rating—4,375 Watts Tungsten
- Snap-out mechanism for fast, easy mounting
- E-Z See Dial for rapid and accurate settings
- Front-Mounted motor to quickly check operation without removing entire mechanism
- 31 cubic inches wiring space prevents cramped and skinned fingers

There's an Intermatic Time Control for nearly every timing need. Get your free catalog showing models, specifications, etc. — circle number 23 on the Graybar postcard.

INTERNATIONAL REGISTER COMPANY

BENJAMIN Extension Cord Reels work right with you!

BENJAMIN Model 995 Electric Extension Cord Reel, shown in use with a Trolley Outlet Box, is only one of a variety of models that can be used as original equipment or replacements on electric appliances and other products. Retractable Cord Reels are used with trouble lights for service stations, garages, and industry. Cord Reels are available for electric power tools.

Get more information on the complete line of Benjamin Cord Reels, as well as Grounding Reels. Just circle number 24 on the Graybar postcard.

BENJAMIN REEL PRODUCTS, INC.

The finest step ladder on the market: BABCOCK's "Mechanics' Step"!

And we're not the only ones who feel this way! Electrical contractors demand this superb ladder because:

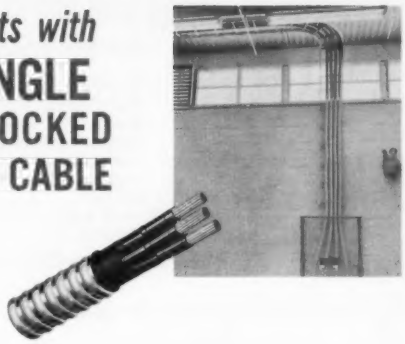
- BABCOCK means QUALITY!
- Long life means fewer replacements, cheaper in the long run!
- Moderate price despite its high quality!

There's a right ladder for every job—and Babcock's new brochure helps you select the right one each time. For your free copy, circle number 25 on the Graybar postcard.

W. W. BABCOCK CO., INC.

item... mail card to GraybaR!

Cut costs with TRIANGLE INTERLOCKED ARMOR CABLE



For new industrial construction and plant expansion . . . for relocating machinery . . . Triangle Interlocked Armor Cable provides power where it's needed . . . fast . . . with minimum labor and material cost. Triangle Interlocked Armor Cable has been installed in many of America's finest and most modern new plants.

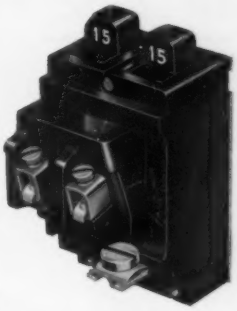
Triangle Armor Cable can be strung quickly, indoors or out, in long unbroken runs. Caterpillar flexibility allows bending around obstructions and corners.

For complete technical information, circle number 26 on the Graybar postcard.

TRIANGLE CONDUIT & CABLE CO., INC.

BULLDOG's new Duplex Pushmatic®

The only space-saving breaker with Coil-Magnetic Protection!



Our brand new edition of the Pushmatic Pocket Guide is now ready; 72 pages of catalog and installation specifications for the complete Bulldog line of breakers and panels. Get yours now! Circle number 27 on the Graybar postcard.

- Two circuits in one compact unit
- Identical solenoid magnetic coil protection for both 15- and 20-ampere circuits
- One single, positive, bolted connection to bus bar
- Famous *Pushmatic pushbutton* convenience

Bulldog Electric Products Division
I-T-E CIRCUIT BREAKER COMPANY

WAGNER BENDER cuts bending time in half

The WAGNER BENDER makes perfect 45° and 90° bends. Made of lightweight, high-grade aluminum alloy for complete ease of handling! Built-in strength for long service, rough-tough handling!

Write today for complete listing of other Wagner conduit bending products—types, specifications and prices. All you do is circle number 28 on the Graybar postcard.

WAGNER MALLEABLE PRODUCTS CO.

Cut Installation Costs with REYNOLDS ALUMINUM Rigid Conduit!

Reynolds Aluminum Conduit weighs only ⅓ as much as steel. It can be handled and installed easily, is easy to cut and thread.

Our illustrated brochure shows the complete range of sizes, and offers many hints on using this time-and-money saving conduit. For your free copy, just circle number 29 on the Graybar postcard.

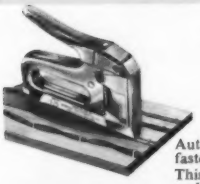
REYNOLDS METALS COMPANY

For maximum current carrying and load interrupting characteristics . . . BOLT-LOC® PRESSURE CONTACT LOAD BREAK SWITCHES

Here's a line of pressure contact load break switches for service entrance, feeder and industrial use that far exceeds maximum operational and safety requirements. Will interrupt extremely high short circuit currents when equipped with current limiting fuses. Furnished standard with quick-break mechanism, replaceable arcing tips, and double slot steel plate arc quenchers. For 1200 to 4000 amperes, 240 and 600 volts. Available unmounted or in free-standing or wall-mounted NEMA 1 enclosures; also, dust-tight and outdoor enclosures.

Our BOLT-LOC Bulletin Number 101 describes the complete line and illustrates all the built-in advantages of these unsurpassed switches. For your copy, circle number 30 on the Graybar postcard.

BARKELEW ELECTRIC MFG. CO.



Staple Wire & Cable Faster, Cheaper with ARROW Automatic Staple Guns!

Automatic, jam-proof specially designed staple guns fasten wire and cable safely, easily and firmly.

This is the *new method for fastening wire* . . . a really useful new tool!

No. T25—fastens any wire up to ¼" diameter; telephone, bell, intercom, thermostat, burglar alarm wires, etc.

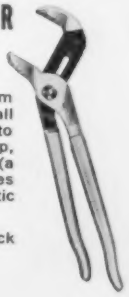
No. T75—fastens non-metallic sheathed cable up to ½" diameter, ROMEX (up to 12-3), inside wiring cable (up to 26 pair!)

No. T50RH—fastens radiant heating wire (this is a general purpose tacker with special RH wire guide).

Circle number 31 on the Graybar postcard for important information.

ARROW FASTENER COMPANY INC.

New CHANNELLOCK® No. 440 GRIPMASTER For a Big Grip on Your Big Jobs



Here's a brand new series of 12 inch pliers from Channellock, designed to grip everything from a small cotter pin to a 2¼" O.D. Pipe! Slender jaws reach into tight places that other tools can't get at. Seven non-slip, undercut channels provide for quick jaw adjustment (a patented exclusive). Extra-strength reinforcing flanges give longer service. Available with cushion-grip, plastic handles or full-polished handles.

For more information on the complete line of Channellock tools, circle number 32 on the Graybar postcard.

CHAMPION DeARMENT TOOL COMPANY

For more information on any

Time at a premium? Speed wiring with BRADY WIRE MARKERS

Select the BRADY Self-Sticking Perma-Code Wire Markers right from our new display. Most popular number and letter codes are arranged in Brady-Pac dispenser boxes for quick, easy selection. You save time, too, when you use Brady Wire Markers . . . wires are marked to tell you which goes where . . . always! Permanent round-the-wire band tells each lead, terminal, circuit unmistakably. Over 3000 different codes to choose from!

Get your free copy of "Ten Timely Tips for Marking Wires". Circle number 33 on the Graybar postcard.

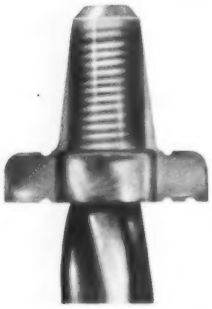
W. H. BRADY CO.

New! BRYANT Smooth-Line Wall Plates for Modern Decors!

Bryant offers a wide variety of switch and plate combinations . . . decorator-inspired for today's modern living. Smooth contours blend unobtrusively with walls and decor. No dust-catching surfaces; easy-to-clean. Available in brown, ivory and pure white.

Additional information is yours free if you circle number 34 on the Graybar postcard.

THE BRYANT ELECTRIC COMPANY



New IDEAL Wire Connector

- Easiest screw-on connector for branch circuit wiring
- Two sizes available for No. 16 through No. 6
- UL-Approved for copper to copper and aluminum to aluminum wire connections

BUILT-IN WRENCH. New wings make it 50% easier to screw on to hardest wires. Wings eliminate wrenches; can be snipped off after applying.

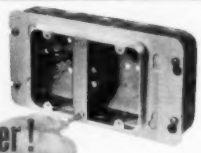
VISIBLE SPLICE. Insulating shell is tough, high dielectric Nylon. You can actually see your splice inside the semi-transparent Nylon shell.

PYTHON GRIP. New tension spring coils grip so tight that wires are actually threaded and crushed together.

Our free literature shows these advantages even more clearly. For your copy, circle number 35 on the Graybar postcard.

IDEAL INDUSTRIES, INC.

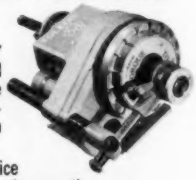
Save up to 50% of installation costs with Edwards VANGUARD Transformer!



Flush transformer mounts inside multigang outlet box, right at the chime or bell. Frequently makes long wire run unnecessary. Can be mounted flush in box together with other low voltage devices. Built-in barrier between primary and secondary side provides safety and service. For complete literature, circle number 36 on the Graybar postcard.

EDWARDS COMPANY, INC.

TOLEDO Power Drive converts hand tools to power instantly!



For faster threading, cutting and reaming of ⅛" to 2" pipe or conduit, or ¼" and larger rod and bolt stock, just attach your hand tools to the "Toledo 58" POWER DRIVE. It is easily transported, weighs only 73 pounds, mounts on bench or stand.

Features spin-torque chuck, 3-jaw centering device and heavy duty gear-train for smooth, fast, accurate operations.

Send for free literature which shows Toledo's complete line of Pipe & Tubing Tools and Machines. Simply circle number 36-A on the Graybar postcard.

TOLEDO PIPE THREADING MACHINE CO.

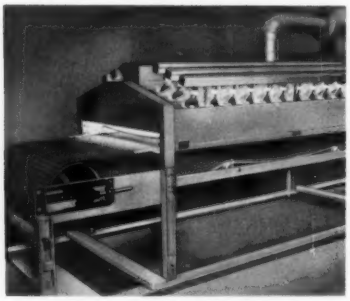
Speed heating and drying with TRIANGLE-Designed INFRARED!

If you want faster, more uniform heating and drying—then call on Triangle's 20 years experience in designing Infrared Ovens and conveyor systems.

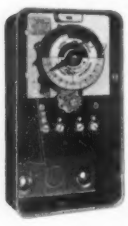
This machine was specially designed for a manufacturer to do his "specific" heating and drying job . . . and do it with a more productive—more profitable operation.

Let Triangle analyze your present processing system, and bring it up to date. Start by getting our free literature. Circle number 37 on the Graybar postcard.

TRIANGLE EQUIPMENT CO., INC.



Eliminate costly call-backs with PARAGON ASTRO DIAL Time Switches



Paragon 4000 Series Time Switches with Astro Dial feature the new 40 amps tungsten design. Free-floating "make" and "break" contacts eliminate contact welding and costly call-backs. Astro Dial operates in relation to the rising and setting of the sun.

FEATURES INCLUDE:

- TUNGSTEN RATING—40 amps . . . highest in general purpose, low-cost switches.
- QUICK-SET DIAL—Easy-add dial trippers.
- SPRING CLUTCH—Permits manual check of switch.
- ASTRO DIAL—Can be set for ON at sunset; OFF at sunrise. Resetting to seasonal changes is unnecessary.

Our fully-detailed literature is yours for the asking. Circle number 38 on the Graybar postcard.

PARAGON ELECTRIC CO.

CRC 2-26 . . . for low-cost prevention of electrical failures due to flooding, humidity and corrosive atmospheres

CRC 2-26 drives and seals moisture out of metal, plastic and rubber surfaces. Corrosive action is stopped and prevented from recurring. Restores electrical characteristics. CRC 2-26 returns its cost many times over in reduced downtime and maintenance expenses.

For more information, just circle number 39 on the Graybar postcard.

CORROSION REACTION CONSULTANTS

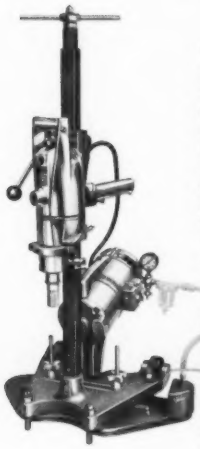
item... mail c

FREE! "How to Use Hand Tools"—from famou CRESCENT TOOLS!

Here's a helpful 36-page booklet that gives complete instructions on how to use wrenches, pliers, hacksaws, snips, chisels, and other tools for special purposes. Well written, clearly illustrated, it's worth having! Send for your free copy of "How to Use Hand Tools", by the Crescent Tool Company, today. Just circle number 40 on the Graybar postcard.

CRESCENT TOOL CO.

New TRUCO Tru-Vac VACUUM BASE anchors drilling machines quickly and easily!



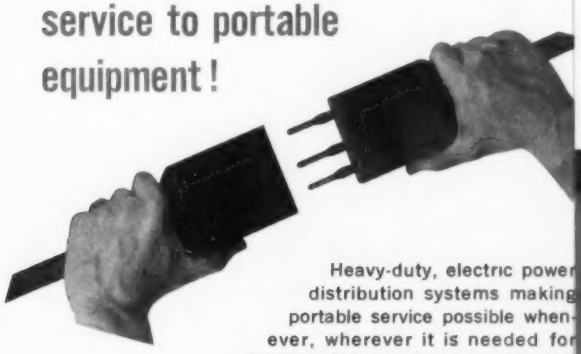
The new TRUCO Tru-Vac Vacuum Base slides under base of any drilling machine and locks it to surface under approximately 1000 actual pounds hold-down. No anchor bolts needed, no jack to ceiling . . . stays absolutely rigid to allow accurate drilling. Releases instantly for wheeling to next location and instant re-anchoring, even into tight 90° corners.

The standard Tru-Vac unit develops vacuum ample for drilling holes up to 14″ diameter, in reinforced concrete, tile, marble, brick, etc., vertically or at any angle. Larger pad available with 3000 pounds hold-down for drilling holes up to 20″ diameter with TRUCO Model "G" drilling machine.

Literature available upon request. Simply circle number 42 on the Graybar postcard.

WHEEL TRUEING TOOL COMPANY

Specify TUFFLINE for heavy-duty service to portable equipment!



Heavy-duty, electric power distribution systems making portable service possible whenever, wherever it is needed for lighting, electric tools and equipment. TUFFLINE products are rugged, safety-engineered; can be quickly and easily installed, extended and removed. TUFFLINE Polarized Plugs, Connectors and Receptacles are waterproof, molded of Neoprene, and provide for equipment grounding. For more complete information, circle number 44 on the Graybar postcard.

TUFFLINE DIVISION • WHITNEY BLAKE COMPANY

CALL GRAYBAR FIRST FOR EVERYTHING ELECTRICAL

Rely on Graybar—one single source for over 100,000 electrical and associated items . . . including the newest, most up-to-date equipment and tools. What's more, when you call Graybar, you get what you need when you need it, thanks to more than 130 completely staffed—and stocked—offices and warehouses located in every key U.S. industrial area! Specialists to consult with you on your problems . . . technical help . . . general advice . . . and unequaled service from employees who own their own company . . . all as close to you as your phone, when you "Call Graybar first for everything electrical"!

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Thanks for your offer. Please send me the literature covered by the numbers I've circled below:

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item... mail card to GraybaR!

FREE! "How to Use Hand Tools"—from famous CRESCENT TOOLS!

Here's a helpful 36-page booklet that gives complete instructions on how to use wrenches, pliers, hacksaws, snips, chisels, and other tools for special purposes. Well written, clearly illustrated, it's worth having! Send for your free copy of "How to Use Hand Tools", by the Crescent Tool Company, today. Just circle number 40 on the Graybar postcard.

CRESCENT TOOL CO.

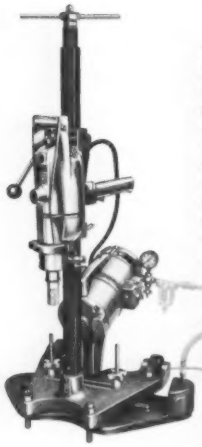
New C-L-X Cable by SIMPLEX gives complete protection!

You may not have occasion to run cable through a fishbowl, but you'll still appreciate the protection afforded by Simplex' new advanced design cable system. It installs "as is", and provides complete, positive protection against liquids, gases, and mechanical damage. As pliable as unsheathed cable, it's available with continuous, corrugated sheaths of steel with outer plastic jacket; and aluminum, copper, or bronze —with or without outer plastic jacket.

Our complete 16-page Catalog Number 1043 gives you all the features and specifications of C-L-X Cable as well as case history reports proving its superior performance. Circle number 41 on the Graybar postcard for your free copy.

SIMPLEX WIRE AND CABLE CO.

New TRUCO Tru-Vac VACUUM BASE anchors drilling machines quickly and easily!



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The standard Tru-Vac unit develops vacuum ample for drilling holes up to 14″ diameter, in reinforced concrete, tile, marble, brick, etc., vertically or at any angle. Larger pad available with 3000 pounds hold-down for drilling holes up to 20″ diameter with TRUCO Model "G" drilling machine.

Literature available upon request. Simply circle number 42 on the Graybar postcard.

WHEEL TRUEING TOOL COMPANY

KELLEMS Grips for HUBBELL TWIST-LOCK® CAPS & CONNECTORS

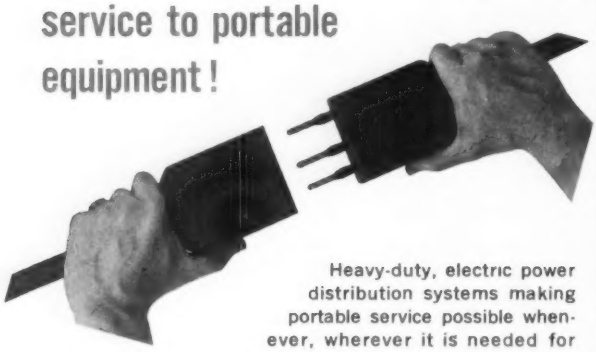
- Eliminates strain from connector terminals
- Absorbs flexure at critical cable connection
- As strong as the "Twist-Lock" itself

Want a free, fully illustrated catalog showing complete specifications and applications on all Kellems Grips? Simply circle number 43 on the Graybar postcard!

® Registered Trade Mark of: HARVEY HUBBELL INC

THE KELLEMS COMPANY INC.

Specify TUFFLINE for heavy-duty service to portable equipment!



Heavy-duty, electric power distribution systems making portable service possible whenever, wherever it is needed for lighting, electric tools and equipment. TUFFLINE products are rugged, safety-engineered; can be quickly and easily installed, extended and removed. TUFFLINE Polarized Plugs, Connectors and Receptacles are waterproof, molded of Neoprene, and provide for equipment grounding. For more complete information, circle number 44 on the Graybar postcard.

TUFFLINE DIVISION • WHITNEY BLAKE COMPANY

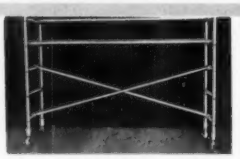
T-P ELECTRIC gives you Three-Phase Advantages on Single-Phase Lines!

Incorporate a T-P Phasing Unit with a three-phase motor and a standard fusible motor control and:

- Reduce initial and maintenance costs;
- Reduce starting surge on power line;
- Improve power factor;
- Eliminate need for heavy, expensive single-phase motors (Detach phasing unit when 3-phase service becomes available).

Choose from three models to fit any application. For complete information on all models, simply circle number 45 on the Graybar postcard.

T-P ELECTRIC & MFG. CORP.



Get up there easier, faster and more safely with ALDEK Aluminum Span Scaffolds

The 29 inch-span scaffold illustrated is available in 6-, 8- or 10-foot lengths. Upper sections easily added. Lightweight, yet rugged aluminum construction complete with locking casters and platform. One span scaffold replaces two trestle ladders and a plank.

TESTED FOR SAFETY

For further information on the complete ALDEK line of ladders, stages and scaffolds, circle number 46 on the Graybar postcard.

R. D. WERNER CO., INC.

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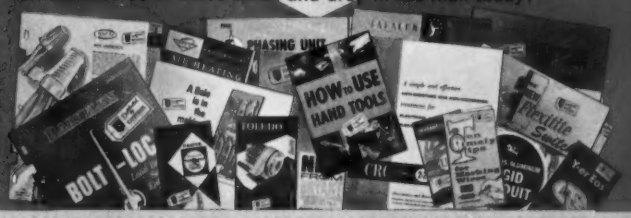
For your free copy of the literature you need, circle the numbers on the reverse of these cards and drop in the mail today!



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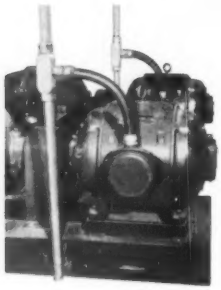


SEALTITE® CONDUIT protects motor lead wiring...

In fact, Sealtite protects all types of wiring hook-ups from moisture, chemicals, abrasion, vibration, etc. Sealtite has a tough polyvinyl chloride cover extruded over a flexible galvanized steel core. Sizes: ⅜"-4" in Type E.F. (extra flexible). Other types: U.A. (listed under Underwriters' Laboratories label service) and H.C. (for hot and cold applications).

For latest literature and specifications, circle number 47 on the Graybar postcard.

ANACONDA METAL HOSE DIVISION
ANACONDA AMERICAN BRASS COMPANY

ILG Fly Fans Protect Your Doorways

ILG Fly Fans provide protection against flies that screen doors alone cannot! Unit mounted above door creates a high velocity air screen across complete opening. Extremely effective wherever food products are processed, handled or displayed.

- B15FF Fly Fan—Centrifugal fan type with double wheels and two-speed permanent-split capacitor motor equipped with sealed ball bearings. Optional: steel cabinet for recessed mounting.
- UA205 ILG jet Fly Fan—Propeller fan type with patented ILG "Q" wheel and three-speed motor for quiet operation. Permanently lubricated bearings. Optional: adjustable velocity generator.

For full information, circle number 48 on the Graybar postcard.

ILG ELECTRIC VENTILATING CO.

ZEUS Portable Electric Power—Electricity...any time...anywhere!

Zeus portable electric generators in two sizes—1250 and 3000 watts—now give on-the-spot power to contractors, builders, campers, sportsmen... and provide standby electricity to farmers and homeowners.

The ZEUS GB-125 weighs only 76 pounds, giving true portability to its 1250 watts, 60-cycle AC, output.

ZEUS GW-300 features both 230 and 115 volt service with 3000 watts of 60-cycle AC power. Weight: 180 lbs.

Built and backed by Borg-Warner, the powerful Zeus employs Permanent Magnet Alternators, eliminating failures and maintenance common to brush and commutator designs.

We'll be glad to send you our complete catalog showing the models available and their superior features. For your free copy, circle number 49 on the Graybar postcard.

Pesco Products Division • BORG-WARNER CORPORATION

Explosion Proof "Hubbellock"® Receptacle and Cap

For Operating Rooms and Industrial Areas

For complete safety in explosive atmospheres, specify "Hubbellock"® Receptacle and Cap. No current flows until cap is rotated 22-25°, preventing arcing when inserted or removed. Gas can't collect in cap—all air spaces are filled with epoxy insulating resin. Cap is vaporproof, waterproof, washable. U.L. listed and NSPA approved for use in Class I, Group C or D, hazardous atmospheres.

For additional data, circle number 50 on the Graybar postcard.

HARVEY HUBBELL, INCORPORATED

IF IT'S NEW AND YOU NEED IT...

WE HAVE IT!

NEW . . . Graybar has the newest—all-weather plastic tape, positive safety receptacles, hand and power tools, wiring materials. Many of these new products you'll find in this booklet.

COMPLETE . . . one-word description of the lines at the Graybar counter, a **must** when YOU need something in a hurry—or to meet tough specs.

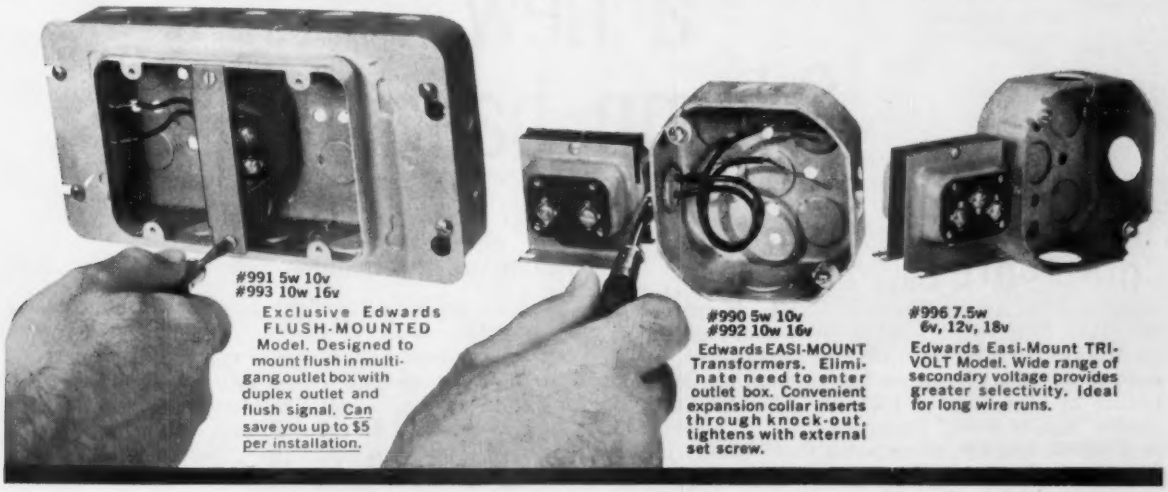
SERVICE . . . another word for Graybar, **the best of service**—at the counter, over the phone or through our Salesmen.

CALL GRAYBAR FIRST FOR EVERYTHING ELECTRICAL

Distributed by GraybaR ELECTRIC COMPANY

NEW EDWARDS EASI-MOUNT TRANSFORMERS REDESIGNED FROM THE CORE OUT TO BRING YOU ALL THESE FEATURES...

1 Self-Restoring Circuit Breaker. Mounted inside coil. Responds to coil temperature only. Eliminates ambient tripping and burnouts. **2 Impregnated Layer-Wound Paper Section Coils.** Protects against abrasion-caused short circuits. **3 25% Smaller and Lighter.** More compact and easier to handle than transformers of comparable ratings. **4 Increased Overload Capacity.** Provides longer life, wider application. **5 Exclusive EASI-MOUNT Feature.** Saves time and trouble in installation. **6 Meets new UL Requirements and NEMA Standard.** First transformer line to meet new UL 120v line side requirement. **7 Application Versatility.** Only full line of chime and doorbell transformers for both flush and surface mounting. ■ Get the whole run-down on this fully re-designed, low voltage transformer line from your Edwards distributor or write: Edwards Company, Inc., 90 Connecticut Avenue, Norwalk, Connecticut.



#991 5w 10v
#993 10w 16v
Exclusive Edwards FLUSH-MOUNTED Model. Designed to mount flush in multi-gang outlet box with duplex outlet and flush signal. Can save you up to $5 per installation.

#990 5w 10v
#992 10w 16v
Edwards EASI-MOUNT Transformers. Eliminate need to enter outlet box. Convenient expansion collar inserts through knock-out, tightens with external set screw.

#996 7.5w
6v, 12v, 18v
Edwards Easi-Mount TRI-VOLT Model. Wide range of secondary voltage provides greater selectivity. Ideal for long wire runs.

EDWARDS

SOLA announces a new 2-lamp ballast

Cool-Core ballast for two 40-watt rapid-start lamps is a new idea from SOLA. It guarantees full-rated light output, using lower-than-ever input: *up to 6 watts less* for the same lumens delivered. Lower wattage additionally means less internal heating, key feature of Cool-Core performance. And SOLA's exclusive "upside-down" insulating principle allows heat to dissipate quickly, along paths that actually utilize the lighting-fixture metal to reduce ballast-case temperature with added efficiency.

The result is extended trouble-free service . . . line-current savings that permit more fixtures per circuit . . . and reduced fixture-operating costs. Yet this improved SOLA Cool-Core ballast *costs no more* than ordinary units! Write today for full facts and prices on the new SOLA Cool-Core, Cat. No. 670-164.

Compare the features . . .

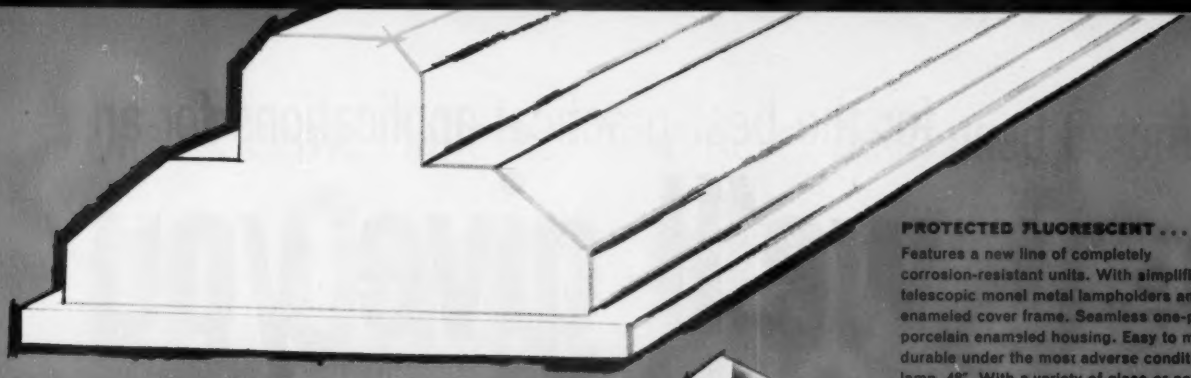
- Provides increased light output, with less power input.
- Allows more fixtures per circuit.
- Improves striking characteristics — Open-circuit RMS voltage is well above minimum requirements. Low-current-crest factor insures long lamp life.
- Cooler in-fixture operation . . . lighter weight.
- UL listed and CBM certified.

SOLA

Division of
Basic Products Corp.

BPC

SOLA ELECTRIC CO.
Busse Road at Lunt,
Elk Grove Village, Ill.
HEmpstead 9-2800.
IN CANADA, Sola-Basic
Products Ltd., 377 Evans
Ave., Toronto 18, Ontario



PROTECTED FLUORESCENT . . .
Features a new line of completely corrosion-resistant units. With simplified telescopic monel metal lampholders and porcelain enameled cover frame. Seamless one-piece porcelain enamsled housing. Easy to maintain, durable under the most adverse conditions. 2 or 3 lamp, 48". With a variety of glass or acrylic covers. U.L. listed.

Any size
Any construction
EVERY industrial application

DUST-TITE
VAPOR-TITE
TEXTILE UNITS
ANGLE VAPOR-TITE

CALL ON BENJAMIN

with the industry's broadest line of

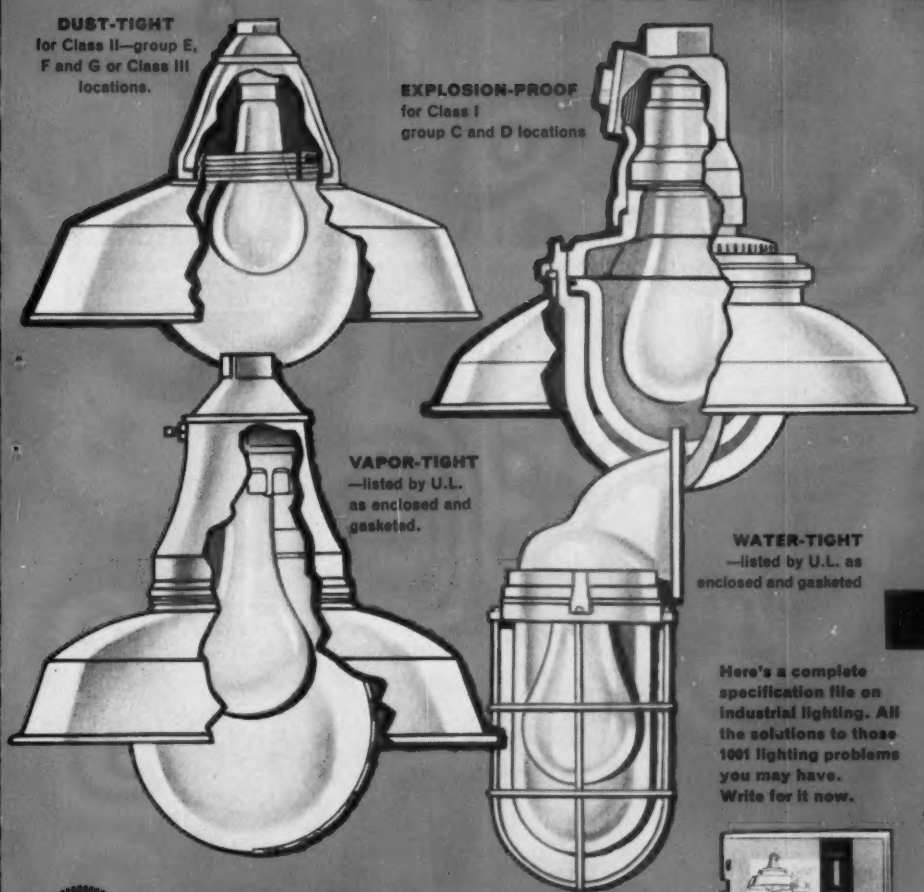
PROTECTED LIGHTING

DUST-TIGHT
for Class II—group E, F and G or Class III locations.

EXPLOSION-PROOF
for Class I group C and D locations

VAPOR-TIGHT
—listed by U.L. as enclosed and gasketed.

WATER-TIGHT
—listed by U.L. as enclosed and gasketed



For more than 50 years Benjamin has been solving industrial lighting problems of all kinds. Every application means an individual problem. Only Benjamin has the answers, because only Benjamin's years of experience could have engineered this line of specific-need industrial lighting fixtures. That's why Benjamin is the greatest name in the lighting market today. Fluorescent, incandescent . . . high bay, floodlighting, protected . . . are just a few of the many in this complete line.

PROTECTED INCANDESCENT FIXTURES
Carefully designed for maximum lighting efficiency and protection in adherence to the National Electrical Code. Closed bead reflector, porcelain enamel finish, corrosion resistant. U. L. listed.

Here's a complete specification file on industrial lighting. All the solutions to those 1001 lighting problems you may have. Write for it now.

THOMAS INDUSTRIES INC.
Benjamin Lighting Division, Dept. BECM-4
207 E. Broadway, Louisville 2, Ky.

- ☐ Please have your Lighting Engineer call
- ☐ Please send catalogs on Industrial Lighting

Name_____

Firm_____

Address_____

City_____ Zone_____ State_____

THOMAS
INDUSTRIES INC.
BENJAMIN LIGHTING DIVISION
207 East Broadway, Louisville 2, Kentucky
The World's Largest Single Source of Lighting for Commerce, Industry and Home.

for the best practical applications for an

we'll give you

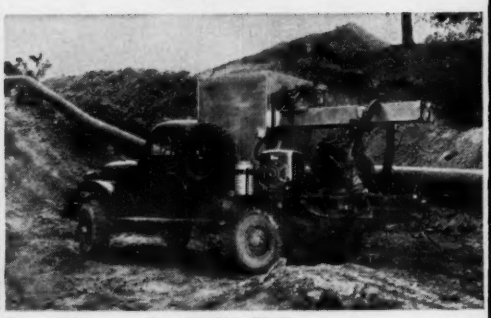
HERE ARE A FEW OF HUNDREDS OF USES FOR ONAN ELECTRIC PLANTS

Standby electric power for
Hospitals
Schools
Office Buildings
Homes
Industrial Processes
Greenhouses
Dairy Farms
Hatcheries
Theaters
Stores
Service Stations
Radio & TV Stations
Hotels, Motels
Bridge Lift Gates
Toll Highway Booths
Restaurants
Banks
Military Installations
Resorts
Airport Towers
Microwave for Railroads and Pipeline Distribution
Sewage Disposal
Water Treatment Plants
Iron Lungs

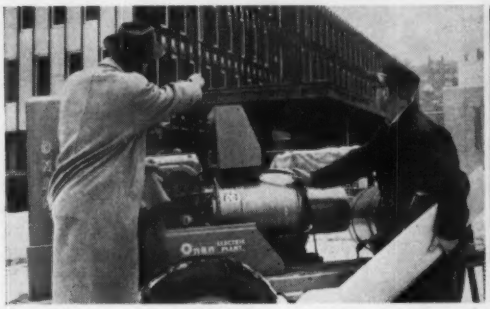
Portable primary power for
Display Vans
Soft Ice Cream Vans
Airport Runway Lighting
Civil Defense Communication
Fire Dept. Lights, Tools
Police Radar, Lights, Communications
Oil Exploration
Mining Equipment
Pipeline Distribution
House Trailers
Magnet Generators
Home Builders, Carpenters
Highway, Dam, Bridge Construction
Electric, Telephone, Gas Utilities
Cemetery Maintenance
Golf Course & Park Maintenance
Electricians
X-Ray Equipment
Bookmobiles

Marine power for
Pleasure Boats
Work Boats

Auxiliary power for lights, communications, appliances on Work and Pleasure Boats.



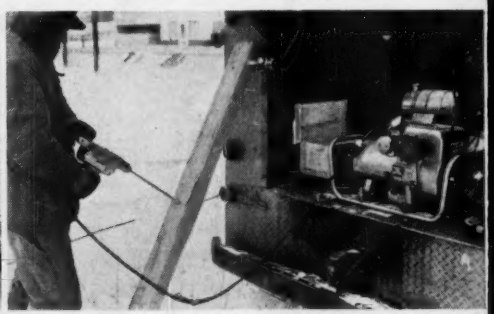
Portable power for pipeline X-Ray equipment, lights, tools and communications.



On-site power for construction tools, lighting in areas beyond mainline service.

Portable power for municipal maintenance equipment; tools, floodlighting.

Standby for critical processes in chemical, ceramic, and other manufacturing plants.



Line repair power and standby for electric, telephone, and gas utilities.

Provides power for lights, cooling, fudge heaters, fans for manufacturing ice cream vans.

Critical electric power for Civil Defense communications and lighting.

Onan Electric Plant that have never been used before

an Onan plant free

We'll give a 1,000-watt air-cooled Onan*(shown below) for each of the ten best applications for an Onan plant that have never been used before. Your idea can apply to any size or type Onan plant—from 500 watts to 230 kw—gasoline or diesel, air or water cooled.

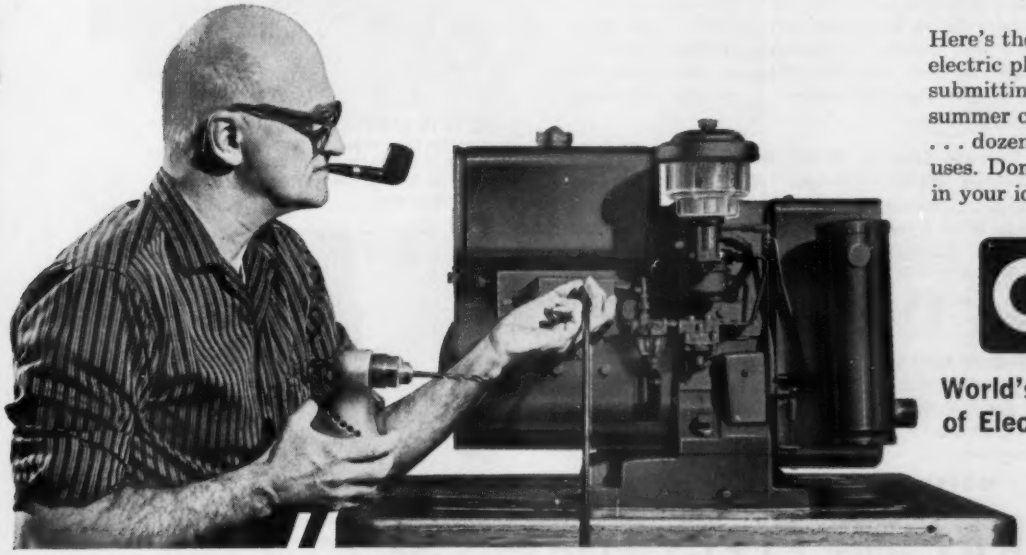
In 1926, when Onan pioneered with the "Ten-Lite"—a 250-watt d.c. plant—there was a clear-cut need: enough power to burn ten electric lamps in hundreds of thousands of homes without electric utility service.

Today, this market is virtually non-existent in the United States. But hundreds of new uses undreamed of in 1926 have increased the need for electric generator sets each year. Thus, because men with ideas continue to find new uses for packaged electric power, Onan continues to build more plants than any other manufacturer.

Quite often, we never know who had the original idea for a new application. And, we're sure, Onan plants are used today in ways we've never heard about. If you have an idea for a new use, it may be helpful to you to see Onan plants at your local distributor. He's listed in the Yellow Pages in every major city. Or, write Onan for free literature.

---

*You may submit as many ideas as you wish, but no more than one Onan plant will be awarded to an individual. There are no restrictions on form of entry . . . you may submit photographs, sketches or a written statement of any length you desire. Onan will judge all entries on the basis of originality, practicality and commercial utility, and decisions of the judges will be final. If the same suggestion or similar suggestions are made by more than one entrant, the first one submitted, according to the postmark, will be eligible for the prize. Winners will be notified on or before July 15, 1961. Entries must be mailed to "New Uses Contest," address below, and must be received not later than June 15, 1961. All ideas submitted become the property of Onan and, whether or not the entries receive an award, may be used commercially by Onan in any way it sees fit with or without acknowledgment of the originator. No entries can be returned.

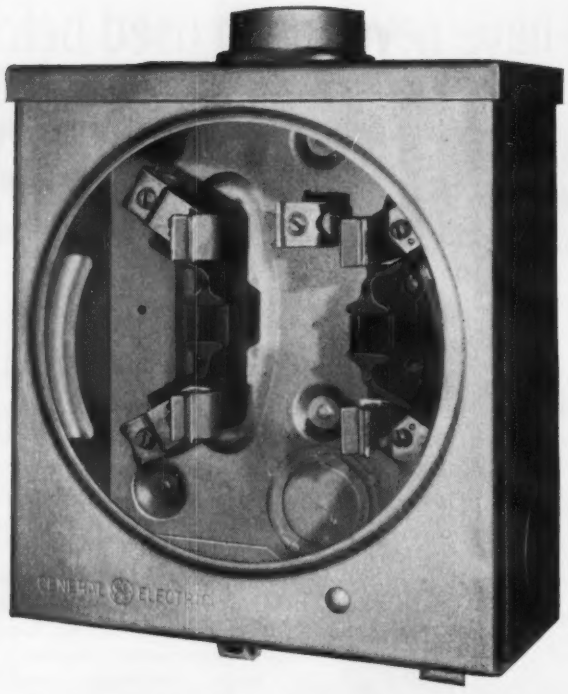


Here's the 1,000-watt Onan electric plant you may win for submitting your idea. Ideal for summer cottage, home standby . . . dozens of portable power uses. Don't put it off . . . send in your idea right away!

Onan®

World's Leading Builder of Electric Power Plants

ONAN DIVISION, STUDEBAKER-PACKARD CORPORATION • 2573 UNIVERSITY AVENUE S. E., MINNEAPOLIS 14, MINNESOTA



NEW Low-Price SI-60 Ringless Sockets

General Electric announces . . . another new line of sockets, the SI-60 for 100- and 200-amp services. Meets requirements of AEIC-EEI-NEMA standards for meter sockets. *Ringless Weatherproof Construction* provides maximum protection. And, G.E.'s new SI-60 line offers exclusive features never before available in a ringless design. *New Terminal Block Assembly* with exclusive one-piece combination jaw and connector strap increases reliability . . . permits an unbroken current path from meter blades to line or load wires . . . provides excellent electrical conductivity with low heat rise. *New Plug-in 5th or 6th Terminal* simplifies shop or field conversion . . . installs in seconds, without the use of tools.

New General Electric Line of SI-60 Sockets also feature 16-gauge zinc-coated steel*. *Die-cast Hubs,* of corrosion-resistant aluminum . . . available in all popular hub sizes up to 2½-inches. *Lay-in Wire Connectors* accommodate either aluminum or copper wire. *Concentric Knockouts* are on both sides, back and bottom; for 1, 1¼, 1½-inch conduit. Your choice of *Large Case Size*—3 sizes in 100-amp, 2 sizes in 200-amp—permits fast, easy wiring.

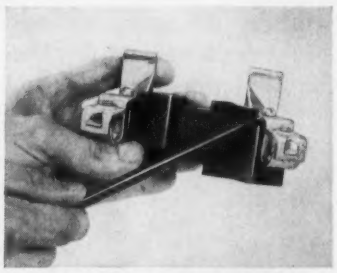
NOW AVAILABLE in 100- and 200-amp ratings. Available soon with manual by-pass. Contact your G-E Sales Office or authorized G-E distributor for full information. Or write General Electric Co., Somersworth, N. H.

** Also available in aluminum.* 711-02

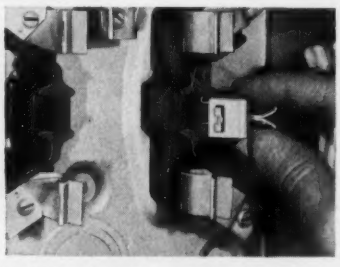
METER DEPARTMENT

GENERAL ELECTRIC

WEATHERPROOF RINGLESS CONSTRUCTION meets AEIC-EEI-NEMA standards. Case is 16-gauge zinc-coated steel with oven-baked finish. Hubs are die-cast of aluminum; staked to case for rigid, weatherproof fit.



EXCLUSIVE ONE-PIECE combination jaw and connector strap—in new terminal block—permits an unbroken current path from meter blades to line or load wires . . . provides greater reliability.



NEW PLUG-IN 5TH OR 6TH TERMINAL, another General Electric exclusive in ringless sockets, installs in seconds—without tools—greatly simplifies shop or field conversion.

Bring out the best in Electric Heating with Honeywell quality controls

The new Honeywell T462 Line Voltage Thermostat offers the very finest for your economy-minded customers. A beauty in any room, this compact new thermostat gives dependable, worry-free performance—high load capacity plus accuracy and responsiveness. The new T462 was especially developed for electric heating, with a control range from 40°-85° with less than a 20° differential. The T462 offers everything you could ask for in a quality-built line voltage thermostat.

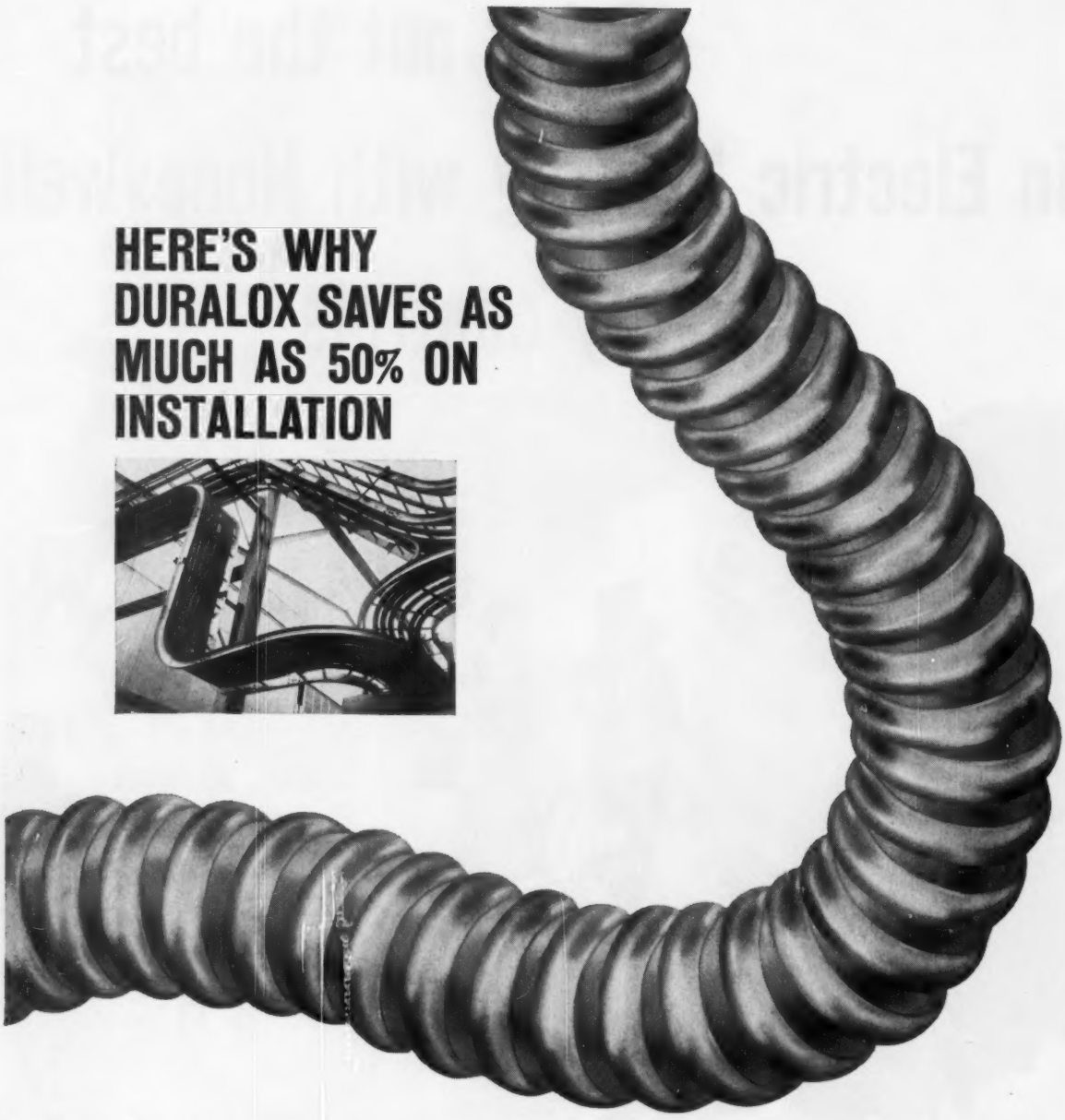
Honeywell

First in Control

SINCE 1885

For complete specifications on Honeywell's full line of electric heating controls—including the most advanced low voltage control systems ever available to the electric heating industry—call your local Honeywell office. Or, write Honeywell, Dept. EC-4-13, Minneapolis 8, Minn.

HERE'S WHY DURALOX SAVES AS MUCH AS 50% ON INSTALLATION



Duralox* needs no conduit—saves time, money, manpower. Duralox is already enclosed in durable, yet flexible, metal armor. Thus, it can be installed *without* conduit—in long runs over and around obstructions, in trays, indoors or out.

You're in—and out—of plants quicker. Make the most efficient use of available manpower.

For your clients—Duralox is easily moved and 100% salvageable—makes their entire plant operation more flexible—a valuable selling plus for you.

And Duralox's lower reactance in higher voltages—because of the close spacing of conductors—results in reduced voltage drop and more efficient power distribution.

Anaconda Duralox Cable is available in all popular sizes and voltages—copper or aluminum conductors with paper, rubber, plastic or varnished-cloth insulation.

Talk to the Man from Anaconda about Duralox for *your* future jobs.

For full information on Anaconda Duralox Cable, write for Bulletin DM 5606 to Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York, Dept. **EFL-1-ECM.**

*Reg. U. S. Pat. Off. 61261C

Duralox has Anaconda Butyl (AB) rubber insulation
for • extra-high resistance against ozone
• exceptional moisture resistance
• 22% more current-carrying capacity
than 70° centigrade insulation

SEE THE MAN FROM
ANACONDA®
FOR BUTYL-INSULATED
DURALOX POWER CABLE

FOR SAFETY YOU CAN SEE REMEMBER THE "V" FOR VISIBLE BLADES!

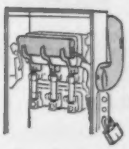
• The men who pull the switches will tell you what can happen when a switch, *believed* to be open —*isn't*. A lot of things can happen—and every one of them is bad. Personnel safety is in jeopardy. Motors can single-phase. Machinery and work can be damaged. Down-time can skyrocket.

Doesn't it make sense to insist on **Visible Blade** construction which gives you a road block against any of those possibilities? Doesn't it make equally good sense to insist on the safety switch which gives you that construction—plus a lot of other performance advantages? Evidently it does, because *Square D switches have never been out of first place in more than 50 years!*

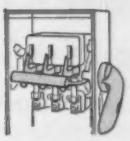
They cost no more...why settle for less?

Square D Company, Mercer Road, Lexington, Kentucky

Extra Safety with Square D's Handle Design



WHEN IT'S **UP** IT'S **ON!**



WHEN IT'S **DOWN** IT'S **OFF!**

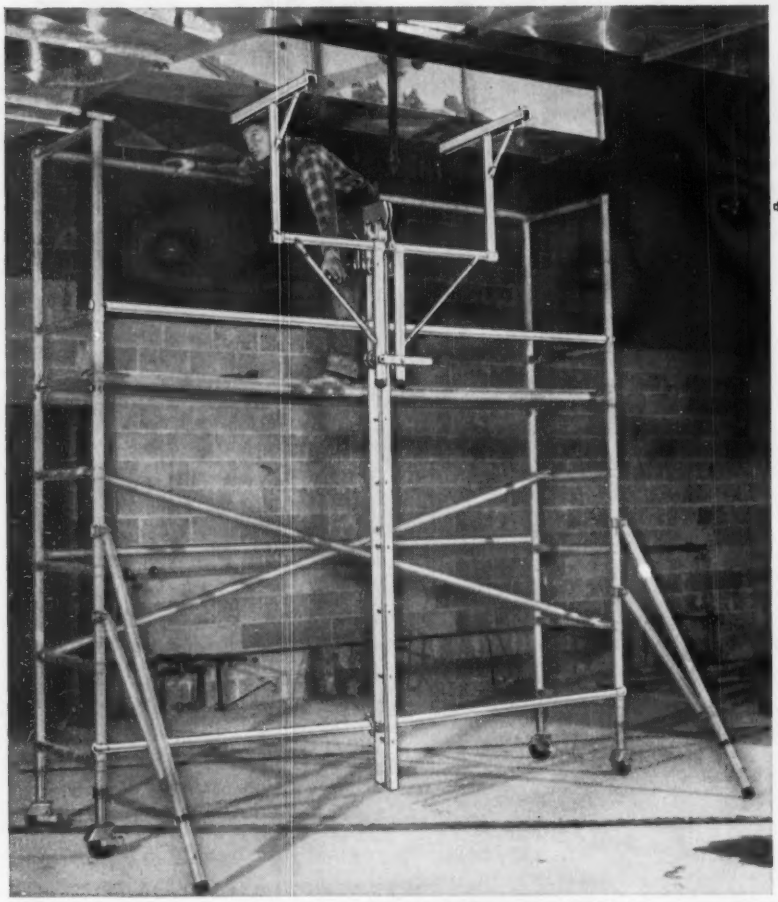
Handle is integral part of switch, not cover. When door is opened, handle remains attached to switch. Eliminates hazard of false handle indication or defeat of padlock provision. When it's padlocked, it's locked!

SQUARE D COMPANY

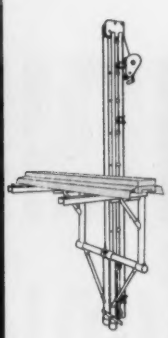
wherever electricity is distributed and controlled

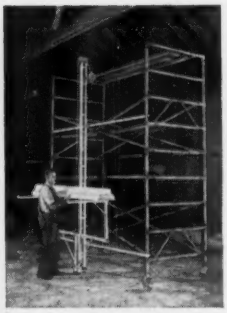
Double your workman's production...

UP-RIGHT mechanical man lifts & positions material for fast, one-man installation

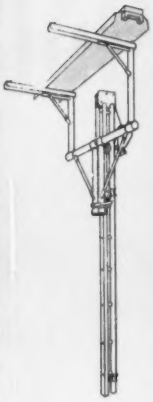


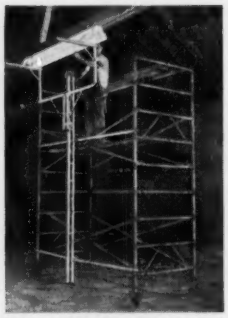
Workman and mechanical man accurately position 9 ft. long air duct for easy, rapid installation.



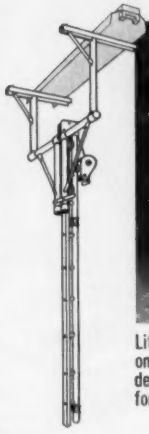


Fixture is placed on lifting arms at convenient chest height.





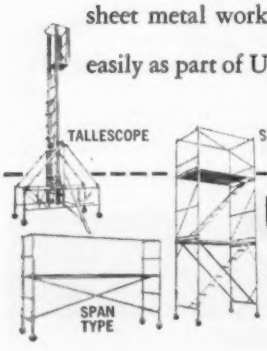
Fixture is elevated along vertical track by winch.



Lifting arms move horizontally on rollers and elevate fixture to desired position above workman for fast, convenient installation.

Mechanical man is an aluminum hoist assembly instantly attachable to any Up-Right or other scaffold. It saves fatigue and manhours in positioning fluorescent fixtures, bus-ducts, conduit, pipe and sheet metal work for overhead installation at any height. Rolled easily as part of Up-Right aluminum scaffold.

Write for descriptive circular



UP-RIGHT SCAFFOLDS

DEPT. 177 1013 PARDEE, BERKELEY, CALIFORNIA

In Canada: Up-Right Scaffolds Ltd., 120 Russet Ave., Oshawa, Ontario

SILICONE NEWS from Dow Corning

Now...Time for the Boys

Electrical Problems No Longer Short Circuit Our Family Fun

Sure, a father should be a pal to his sons . . . and, mine are at the age when they need and appreciate my companionship most. But when you're lucky enough to be employed at an assembly plant that's doubled capacity twice in the past eight years, you've got more than a full time job . . . and family activities frequently have to take a back seat.

During these eight years I've come up through maintenance to Assistant Plant Manager. It started when I suggested we replace certain troublesome motors with silicone insulated units. Then, when we doubled our plant the first time, I suggested we could double our electrical load capacity in the same floor space by using silicone insulated transformers. Just before our last expansion, my boss was made Plant Manager and I moved up to his assistant. He's taught me a lot . . . and I think I've helped him. We're a good team. And, for the first time since I started working, I'm finding time to really enjoy my boys. By the way, the car we're restoring is a Model A. No, not a Ford . . . a Dusenberg.

I think my progress is the result of plenty of hard work and a good eye for new and better ways of doing things. One of the most important things I've ever read was an advertisement on Dow Corning silicone insulation for electrical transformers and motors—just as you're doing now. I wrote for more information. Why don't you?

For brochure, "Specify Silicone Insulation and Save", Write Dept. 2816.

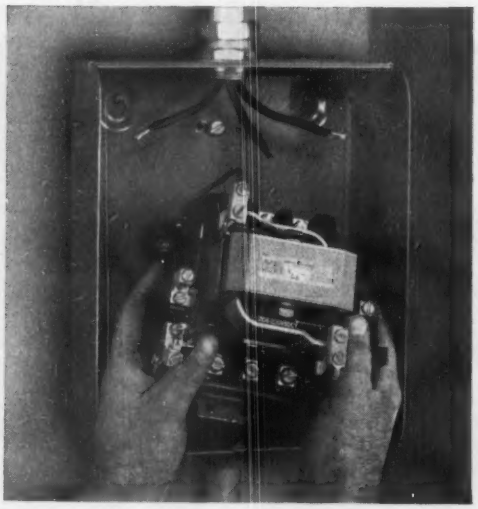
first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.

General Electric CR106 Magnetic Starters . . .

HOOK-UP TIME: 3 MINUTES

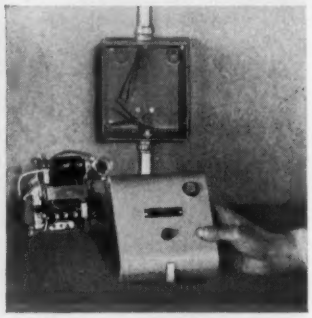


To mount starter in case, slip key-hole slots over three mounting screws and tighten. Next, insert stripped leads into pressure-type terminals located in front and tighten. All line terminals are at top, all load terminals at bottom.

Time elapsed? Only *three minutes.* Multiply this times the number of starters you install every year, and count your dollar savings with General Electric CR106 Starters.

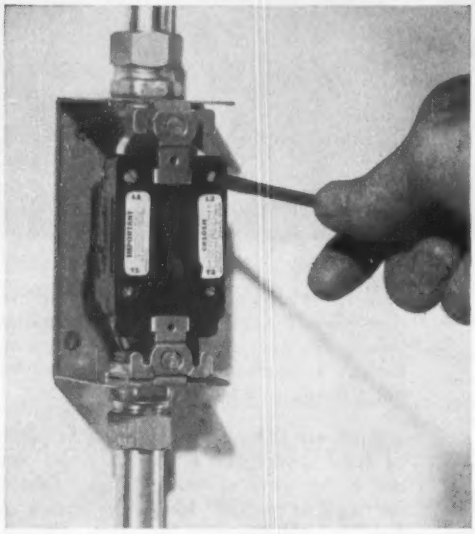
TYPICAL MODIFICATION TIME: ADD INDICATING LIGHT IN 3 MINUTES

General Electric offers industry's widest selection of starter field modification kits to meet special operating conditions. Off-the-shelf kits are available for installation of indicating light, push button and selector switch in starter covers; auxiliary contacts; third overload relay; different-voltage coil; and (on combination forms) fuse clips for different current or voltage.



General Electric CR101 Manual Starters . . .

HOOK-UP TIME: 2 MINUTES

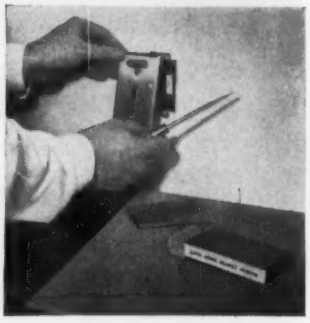


First, insert stripped line leads in pressure-type terminals at top and load leads in bottom terminals and tighten. Next, position starter and tighten two mounting screws.

Insert heater. Exclusive design plugs in from the front and is keyed to prevent incorrect insertion. Compare hook-up time with that required for any other manual starter and see how you save with General Electric CR101 Starters.

TYPICAL MODIFICATION TIME: ADD INDICATING LIGHT IN 1 MINUTE

Kit packaging of G-E CR101 manual starter components gives you unequaled modification versatility. Kits available for single or combination forms include flush plates with or without indicating light, front cover with or without indicating light, and back box.



Your nearby General Electric distributor has a complete line of starters and modification kits in stock. Ask him for Publications GEA-7020 and GEA-6358, or write Section 812-06, General Electric Co., Schenectady 5, N. Y.

You get **MEASURABLE ADVANTAGES**
WITH GENERAL ELECTRIC CONTROL

Progress Is Our Most Important Product

GENERAL ELECTRIC

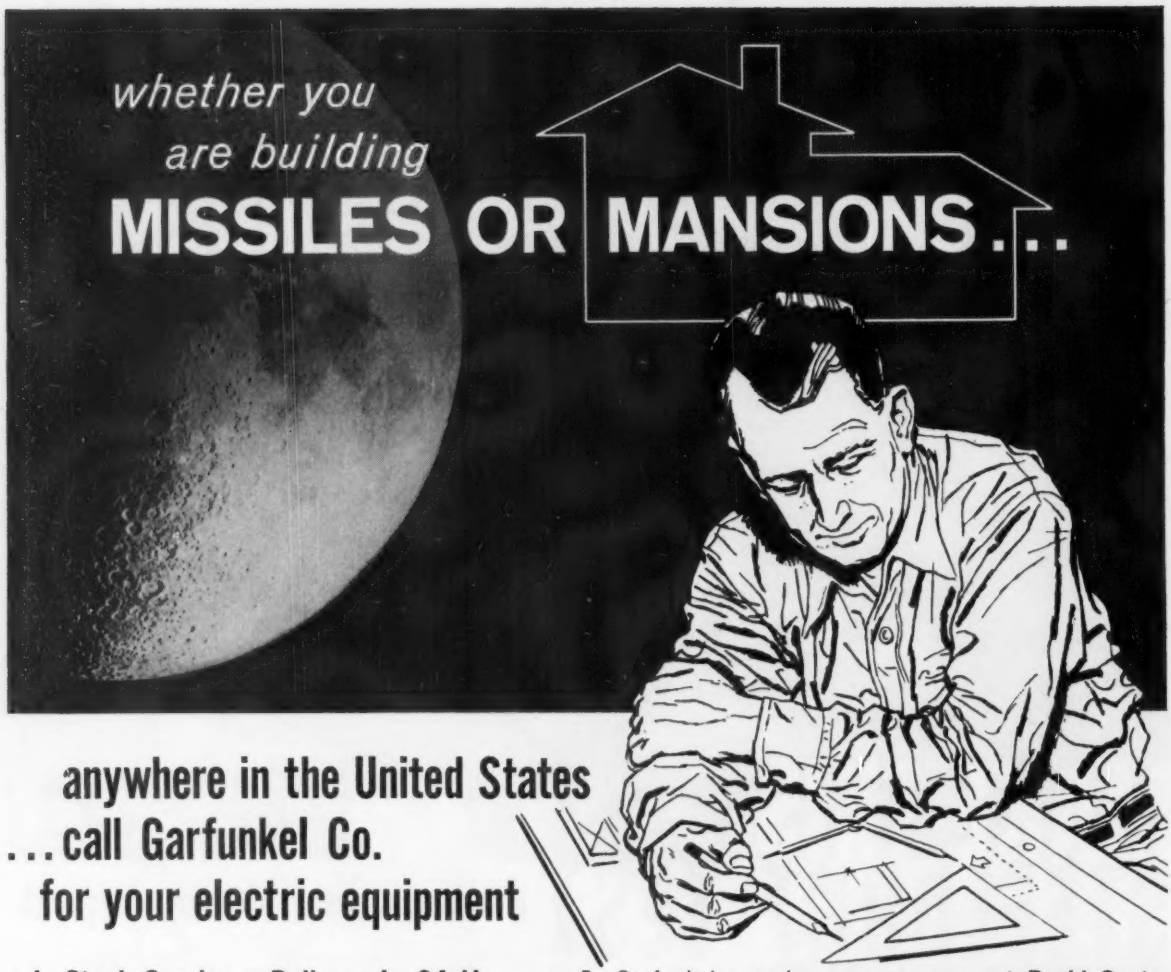
MAKE THIS STEELDUCT TEST ...

BEFORE YOU BUY RIGID GALVANIZED CONDUIT

Hand run a coupling on Steelduct uniform galvanized threads. The coupling will run free but not loose. Steelduct galvanized threads are sharp and clean because the Steelduct galvanizing process produces a measured uniform coating, free of any excess deposits of zinc. Uniform galvanized threads by STEELDUCT cut installation costs by eliminating rusty threads and assuring free running couplings.

THE STEELDUCT COMPANY

REPUBLIC STEEL BUILDING YOUNGSTOWN, OHIO



anywhere in the United States ...call Garfunkel Co. for your electric equipment

• In-Stock Service • Delivery In 24 Hours • Special Wire & Cables in all sizes, types and voltages • Transformers • Circuit Breakers Country wide affiliates distribute major lines.

Garfunkel Co. was a major supplier of electrical equipment for the following installations:

Federal Office Bldg. & Courthouse, St. Louis and Oklahoma City
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Dade County Jail and Courthouse, Dade County, Fla.
Travelers Insurance, Los Angeles, Calif.
Atomic Energy Commission Major Switch Gear, Princeton, N. J.
Titan Missile Base (6 sites), Denver, Colo.
Atlas Missile Base (12 sites), Plattsburgh, N. Y.
Missile Base, Camp Locey & Salinas, Puerto Rico
Public Service Office Bldg., Denver, Colo.

Garfunkel experience means you get **Rapid Quotations, Best Prices** and **Immediate Delivery.** For any job, for the complete job, in fact wherever special electrical or lighting equipment is needed:

Write or wire Garfunkel Co., 420 Hoboken Ave., Jersey City, N. J. Tel: OL 6-2900 (NYC—WO 4-1778); Teletype: JCY 1124, Western Union—FAX or any of the Garfunkel Co. affiliates:

Central Electric Supply Co. Orlando, Florida
Consolidated Electric Supply, Inc. Melbourne, Florida
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Consolidated Electric Supplies, Inc. West Palm Beach, Florida
Edwards Wholesale Elec. Supply Co. New York, N. Y.
Consolidated Southern Electric Supply Co., Miami, Florida
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J. D. Saltzman, President

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WESTINGHOUSE APPARATUS Lighting Fixtures, Lamps

GENERAL ELECTRIC Construction Materials

WHOLESALE ELECTRICAL DISTRIBUTORS
420 HOBOKEN AVENUE, JERSEY CITY 6, NEW JERSEY

HANDIER THAN AN EXTRA HAND — that's Slipknot's exclusive, permanent plastic cutter-and-case — yours at no extra cost! This new tool saves time, tape and temper — and keeps your favorite tape clean and ready, whatever the job!

NOW... No. 7 SLIPKNOT
PLASTIC ELECTRICAL TAPE ...

ALWAYS CLEAN

in the NEW **FLIP-n-CUT** pat. pending

INSTANT TAPE DISPENSER

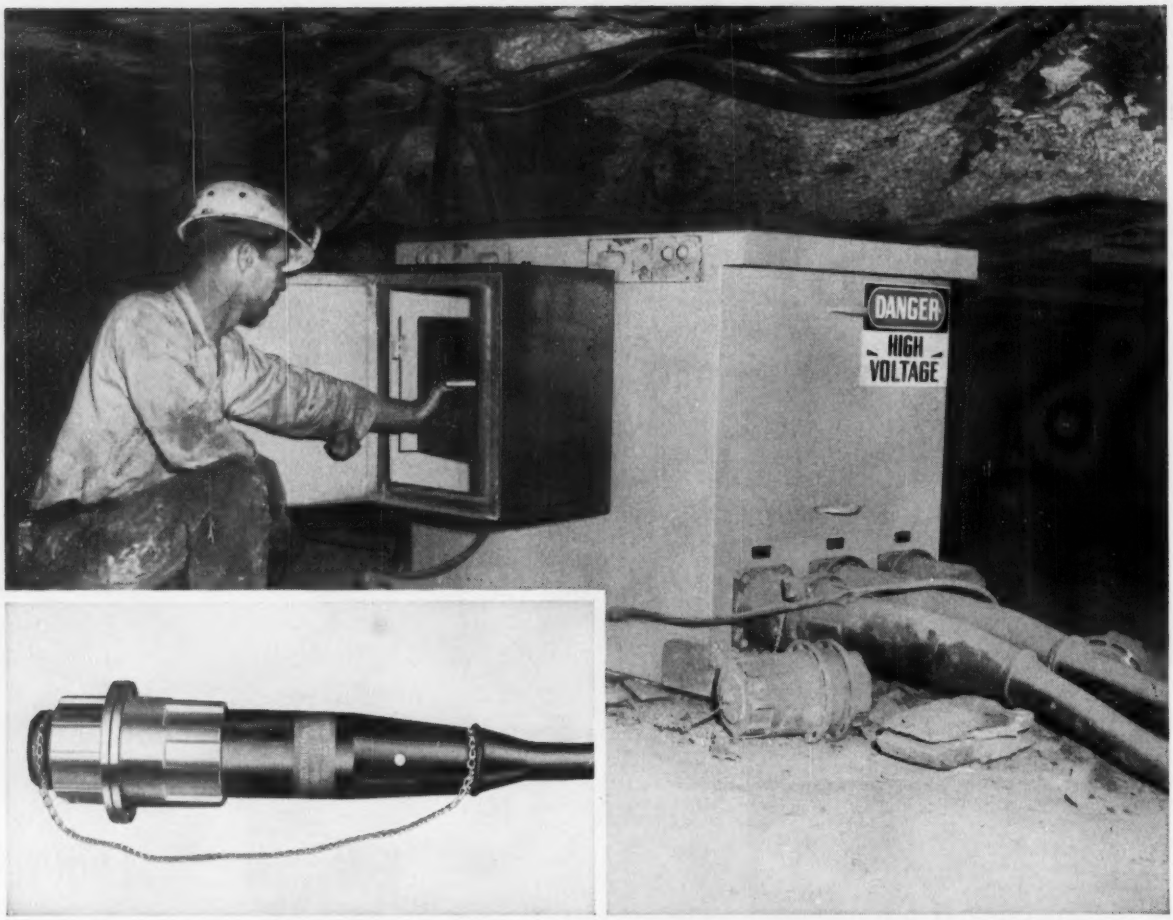
FREE... WITH EACH 66' ROLL

PLYMOUTH RUBBER COMPANY, INC.

QUALITY SINCE 1896 CANTON, MASSACHUSETTS

TAPES BY PLYMOUTH RUBBER COMPANY, INC. — SOLD ONLY THRU RECOGNIZED DISTRIBUTORS

FL-3



Cable connectors molded of HYPALON synthetic rubber are becoming key elements in modern high-voltage power systems. After two years' field use, electrical engineers report not one breakdown due to corona attack.

New HYPALON® cable connectors defy corona at 7500 volts

Higher-voltage portable equipment for plants and mines . . . and the resulting increase in corona discharge . . . prompted development of this new HYPALON cable connector that is virtually corona-*proof*. Rated at 7500 volts, the unit is the result of five years' research by Joy Manufacturing Co., St. Louis, Mo. Du Pont HYPALON proved to be the only covering material that met the stringent operating requirements of this high-voltage connector.

Corona resistance is just *one* of the properties that makes HYPALON well suited to many types of electrical applications. Industrial users have long relied upon the ozone immunity of HYPALON, its resistance to heat, flame, factory fumes, chemicals.

Users of triplex cable find colored HYPALON jacketing and insulation permits rapid phase identification and provides better sunlight, weather and abrasion resistance than conventional jacketing materials. And because HYPALON synthetic rubber is a *vulcanized* jacketing material, there's no problem with hot or cold flow.

Investigate the unusual properties of Du Pont HYPALON. Learn how it can improve jacketing and insulation performance in your operation. Write: E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept. ECM-4, Wilmington 98, Delaware.

DU PONT
REG. U. S. PAT. OFF.

HYPALON®
SYNTHETIC RUBBER

Better Things for Better Living . . . *through Chemistry*

Announcing the newest addition to the Amprobe family

NOW

TEST VOLTS AMPS AND

OHMS

FOR ONLY $29.85

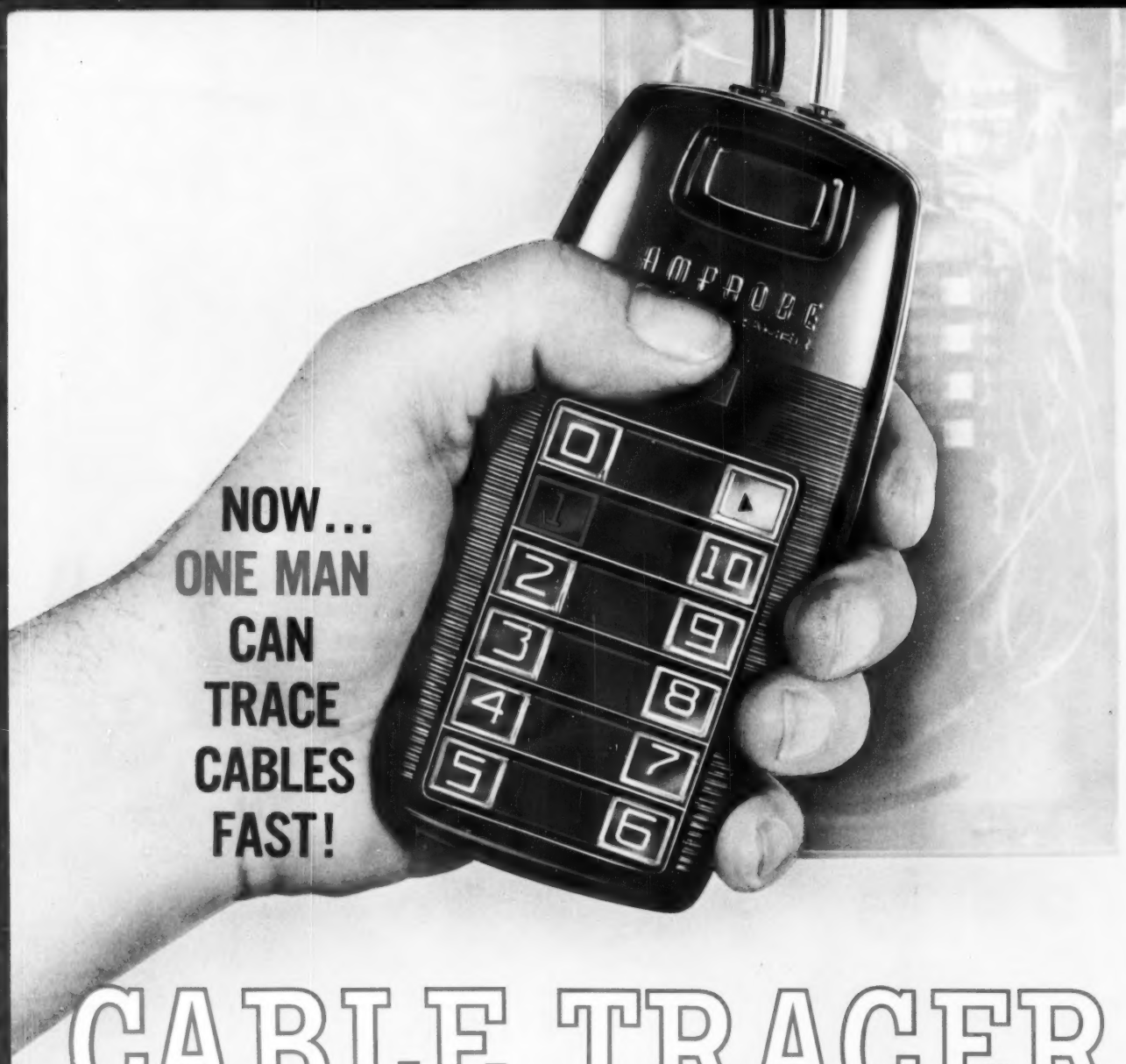
You read right. The AMPROBE JR. *Testmaster Kit* lets you *read* voltage on a calibrated scale (not just an indication), measure amps *without* interrupting service *and* test for resistance...at half the price you'd expect to pay for a tool of similar versatility

The Kit consists of the AMPROBE JR., an ohmmeter attachment, test leads, a leather carrying case and the AMPROBE *Energizer* ("splits" double-conductor cords for direct readings at outlets, or boosts the sensitivity of the instrument 10X for readings on fractional h.p. motors).

Pick the range that best fits your job from six rugged, lightweight models: 0-25 to 0-100 amp; either 0-125/150 or 0-150/600 volts AC; 25 ohms mid-scale. For more details about this newest addition to the most-complete family of pocket-sized, snap-around test instruments in the world, see your Distributor or write for Catalog sheet AAD-1.

PYRAMID INSTRUMENT CORP., LYNBROOK, N. Y.

Canada: Atlas Radio Corp., 50 Wingold Ave., Toronto.



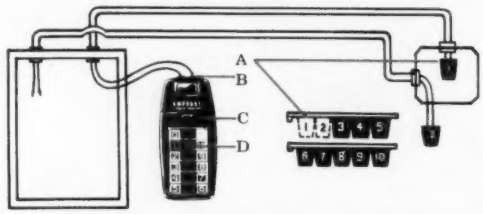
NOW... ONE MAN CAN TRACE CABLES FAST!

CABLE TRACER

Now you can trace conductors in cables and conduit– *10 times faster* than ever before–and leave your helper free to finish other jobs quickly and profitably. A tracing *system* in itself, revolutionary new CABLE TRACER lets you search–and *unmistakably identify*–up to 10 separate circuits simultaneously, even in the dark and when color coding is absent or obscured by age and dirt. It can also test for opens and shorts.

CABLE TRACER is a completely self-powered precision tool which forever eliminates the need for clumsy buzzers. Designed by the makers of famous AMPROBE snap-around test instruments, new CABLE TRACER is simplicity itself to use. At the press of a button, a number lights up to identify the conductor. What's more, CABLE TRACER will pay for itself in saved labor costs after only three jobs. It is supplied with three test leads and ten Station Blocks in a belt-looped carrying case made of top-grain cowhide leather. Test-try CABLE TRACER today; your AMPROBE Distributor has a live-action demonstrator. Or write for free Catalog Sheet CT-10.

only **$39.50**



1. Simply plug one end of conductors to be traced into numbered Station Blocks (A).
2. Plug other ends into Receptacle (B) at top of CABLE TRACER.
3. Press Indicator Button (C).
4. The number on CABLE TRACER'S Indicator Panel (D) corresponding to the Station Block at the other end of the conductor being traced (No. 1, in this case) *lights up* to provide identification–instantly, clearly, unmistakably! Using all the Station Blocks, ten conductors can be traced at one time.

PYRAMID INSTRUMENT CORPORATION, LYNBROOK, NEW YORK *Canada: Atlas Radio Corp., 50 Wingold Ave., Toronto, Ont.*

THERE **IS** A DIFFERENCE IN I·T·E UNI-PAK LOADCENTER **BOXES**

14¼" BOXES FIT SNUGLY BETWEEN STUDS

BUILDS-IN BEAUTIFULLY

No need to build up the stud side with scrap lumber when you use a 14¼" wide Uni-Pak Loadcenter.

I-T-E has separated the box from the interior . . . the interior from the trim. You can buy the box separately, rough-it-in, and add the interior and trim later as the job progresses. All Uni-Pak boxes have a standard 14¼" width and fit snugly between 16" stud centers. It almost "holds itself in place" as you secure with nails or screws to studs through quarter-inch knockouts.

Get the whole story on America's easiest to install, most versatile Loadcenter. Write I-T-E Circuit Breaker Company, Walker Division, 125 Bennett Street, N.W., Atlanta 9, Georgia. Ask for Bulletin C-63.

The HEART of HOUSEPOWER ⚡ Nerve-Center of The Medallion Home

I-T-E CIRCUIT BREAKER COMPANY
WALKER DIVISION

Another **NEW** General Electric Ballast Development . . .

THIS CAPACITOR IS DESIGNED TO PREVENT RUPTURE!

New Thermal Link deep within capacitor roll protects against excessive internal temperatures which may cause rupture of the capacitor case. Also, a new bushing assembly acts as an effective barrier to seal against bushing seepage. Result: longer ballast life.

Introducing

NEW GENERAL ELECTRIC *Bonus Line*

Fluorescent Ballasts

DESIGNED TO...

- **eliminate hazards to people and property**
- **eliminate need for individual ballast fusing**
- **eliminate leakage**
- **provide longer ballast life**
- **be interchangeable with standard models**

WITH NO SACRIFICE IN SOUND PERFORMANCE!

Another **NEW** General Electric Ballast Development . . . **SPECIAL THERMAL PROTECTOR** makes ballasts safer than ever before!

Unique Thermal Protector is designed to de-energize the ballast *permanently* at end-of-life failure, preventing compound softening and eliminating ballast leakage. This assures full-life protection against hazards to people or property.

General Electric proudly announces new Bonus Line fluorescent ballasts, designed to offer you—for the first time—full protection against the hazards sometimes associated with ballast end-of-life failure.

This new ballast design, *available in most popular ratings for indoor commercial and industrial applications,* features two outstanding new General Electric developments that make it safer than standard ballast designs:

1. A new Thermal Protector has been developed and tested for several years in General Electric laboratories. The Thermal Protector de-energizes the ballast before it reaches the critical internal temperatures at end of life that cause ballast filling compound to soften or melt. This non-resetting Thermal Protector completely eliminates any need for individual ballast fusing.
2. A newly developed, two-way improved General Electric capacitor features a unique Thermal Link designed to overcome capacitor rupture and leakage which sometimes occur at end of life. Also, the new capacitor has a new bushing assembly which contributes to longer ballast life.

New Bonus Line ballasts are dimensionally, thermally, and electrically interchangeable with standard General Electric ballasts of same ratings. They meet—*and, in certain respects, exceed*—all appropriate industry standards. And you get all these ballast added values without sacrifice in sound performance. General Electric ballasts are still the quietest ballasts available!

In short, new G-E Bonus Line ballasts give you added years of safe, reliable, quiet performance. They're engineered to eliminate leakage, smoke—even the more violent conditions which sometimes occur at end of normal ballast life.

Your General Electric ballast sales engineer will be proud to give you full information on new G-E Bonus Line ballasts for your lighting applications. Contact your nearby G-E sales office or write for Bulletin GEA-6912 to Section 403-01, General Electric Co., Danville, Illinois.

Progress Is Our Most Important Product

GENERAL ELECTRIC

INTRODUCING KAISER ALUMINUM

KINGFISHER

RIGID ALUMINUM CONDUIT

*AMAZING K-40 SILICONE LINING CUTS FISHING WORK IN HALF!

New Kaiser Aluminum Kingfisher Conduit—with exclusive lining of clear, glassy-hard K-40 Silicone—lets cables slip through with 39 to 61 per cent less pull! (Actual tests with steel and other aluminum conduit.)

Keep bids low—two ways! First, with aluminum's light weight, you reduce man-hours for handling and installation as much as 35 per cent. And second—because Kingfisher's new lining saves you extra man-hours during cable-pulling, your total labor cost is reduced even more! Result: more successful bids for you!

Ask for Kaiser Kingfisher by name. Kaiser Kingfisher Conduit is made only by Kaiser Aluminum—of quality-controlled alloy for high strength, easy working. Corrosion resistant, even in concrete! Only Kaiser Kingfisher offers all the advantages of aluminum plus the new K-40 Silicone lining that cuts fishing work in half!

NOW AVAILABLE—COMPETITIVELY PRICED Your Kaiser Aluminum Electrical Distributor has Kingfisher Aluminum Conduit. Call him.

KAISER ALUMINUM*

NEW LEADERSHIP IN THE WORLD OF ALUMINUM

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See HONG KONG and MAVERICK weekly on the ABC-TV Network

THW building wire insulated with BAKELITE Brand vinyl is listed by Underwriters' Laboratories for 75 deg. C. service in either wet or dry locations.

THW Wire Insulated With BAKELITE® Vinyl MEETS THE DEMAND FOR EASIER INSTALLATION

THW building wire insulated with BAKELITE vinyl provides faster, neater wire installations . . . thanks to its ease of stripping, splicing and pulling through conduits. These advantages can result in substantial savings in labor costs.

Along with the benefits resulting from easier installation, the higher heat resistance of THW wire insulated with BAKELITE vinyl provides these additional bonuses: (1) greater protection against the heat generated by overloads and high environmental temperatures, (2) greater current carrying capacity in the same conductor size, and (3) thinner insulation on larger sized conductors permitting the use of smaller conduits or increased circuits in existing ones.

Furthermore, insulation of BAKELITE vinyl is tough, withstands abrasion and rough handling, and possesses superior resistance to moisture and most chemicals . . . leading to long cable life and dependable service.

Economical, efficient, and safe—these are the primary reasons why more electrical contractors and engineers are specifying and using THW building wire insulated with BAKELITE vinyl. For more information, write today to Dept. IP-41D, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Ave., New York 17, N. Y.

In Canada: Union Carbide Canada Limited, Toronto 12.

UNION CARBIDE

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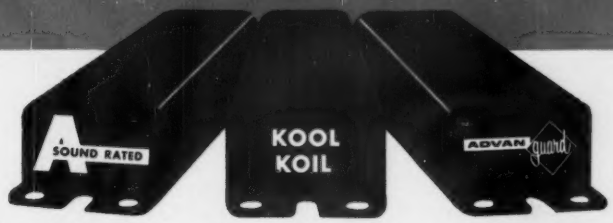
ADVANCE®

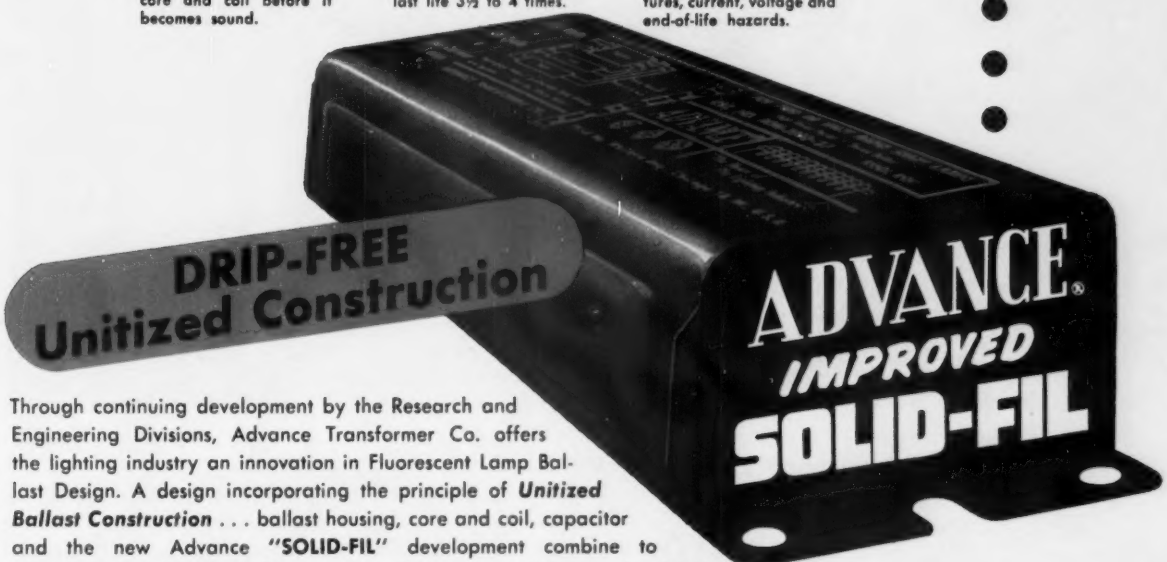
First with these major contributions to the lighting industry . . . . and NOW



Utilizing a special thermopliable compound that absorbs the vibration of core and coil before it becomes sound.

Up to 15% more light output, operate 15° to 20° cooler, increase ballast life 3½ to 4 times.

Thermally protected to safeguard against failure from excessive temperatures, current, voltage and end-of-life hazards.



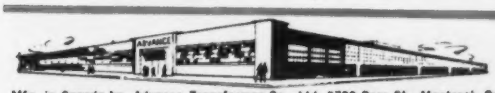
Through continuing development by the Research and Engineering Divisions, Advance Transformer Co. offers the lighting industry an innovation in Fluorescent Lamp Ballast Design. A design incorporating the principle of ***Unitized Ballast Construction*** . . . ballast housing, core and coil, capacitor and the new Advance **"SOLID-FIL"** development combine to offer ***Drip-Free Unitized Construction***. This exclusive Advance development differs from other types of solid fill materials in that it retains a pliable consistency, and will not become brittle with age or heat, permitting retention of its excellent thermal and sound deadening characteristics. Accelerated heat tests, far above what will be experienced in an actual lighting installation, **proved conclusively no deterioration or drippage** of the Advance **"SOLID-FIL"** development.

Advance Improved **"SOLID-FIL"** Fluorescent Lamp Ballasts dissipate heat faster, provide greater safety, and offer the lighting industry the opportunity to utilize a quieter operating solid fill ballast. Ask your Advance representative or write for further details.

- **DRIP-FREE**
- **QUIETER**
- **MORE EFFICIENT HEAT DISSIPATION**
- **GREATER SAFETY**

Approved By CBM (Certified Ballast Manufacturers)

"The Heart of the Lighting Industry"



Mfg. in Canada by: Advance Transformer Co., Ltd. 5780 Pare St., Montreal, Quebec

ADVANCE® TRANSFORMER CO.

World's Largest Exclusive Manufacturer of Fluorescent Lamp Ballasts

2950 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.

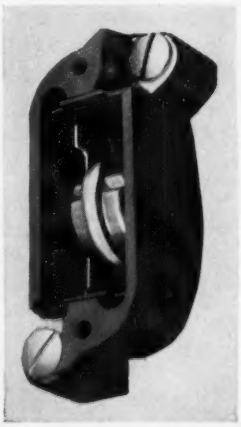
Switch to Silence!

General Electric Silent Mercury Switches last years longer than other switches — have only one moving part

You please everybody when you install G-E Silent Mercury Switches. They last years longer than snap-type or quiet-type switches — are completely silent — have a smooth, luxurious action that people are quick to appreciate.

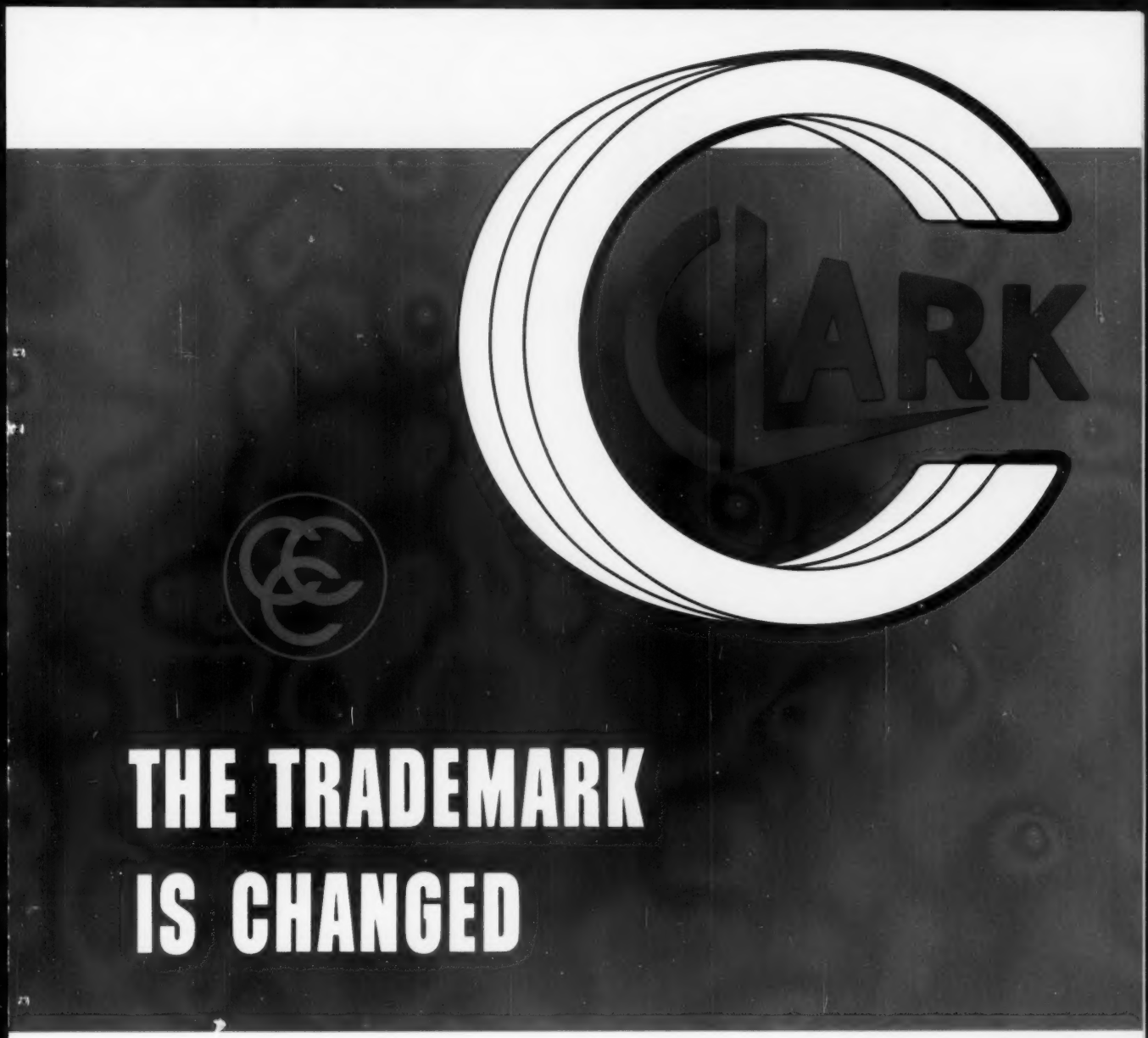
Specification Grade, 10A-125V T, 15A-120V AC. U.L.-Listed; meet Federal, REA specifications. Available with lighted handles, for dark locations. General Electric Company, Wiring Device Department, Providence 7, Rhode Island.

The only part that moves in G-E Silent Mercury Switches is this smooth-turning button, in which pools of mercury flow softly together or apart. There are no snapping springs, blades or mechanical contacts. Lab tests indicate the average G-E Silent Mercury Switch can be turned ON and OFF more than 500,000 times!



Progress Is Our Most Important Product

GENERAL ELECTRIC



THE TRADEMARK IS CHANGED

...to match the high performance standards of the nation's top-quality electrical control equipment

Soon you will see this new trademark on Clark control devices and systems. Behind this symbol are the precise engineering and exacting production methods which make possible the high standards of quality for which Clark is famed. Behind it are men with the know-how to create the longest lived, sturdiest, most efficient electrical controls. Behind it are answers to your needs for everything from standard equipment such as motor starters, relays and push buttons to complete engineered systems.

For help in solving your control problems, contact your local Clark distributor or district sales office, or write direct. *The Clark Controller Company* • Main Plant: Cleveland 10, O.—Western Plant: Los Angeles 58, California—In Canada: Canadian Controllers, Limited, Toronto, Ont.

McGILL® PORTABLE LAMP GUARDS are always a little better ...and all are UL inspected

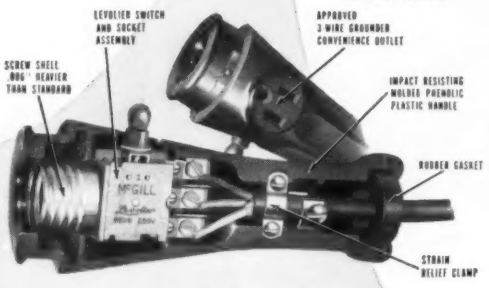
- Rugged, steel wire cage. Spot-welded with extra heavy zinc plated, chromate finish.
- Tough, gray molded phenolic handle resists impact, heat oils, greases, some acids, moisture and abrasion.
- Concentrating end lens. • Convenience hook.
- Approved 3-wire grounded convenience outlet.
- Exclusive McGill LEVOLIER Switch. • Rotary reflector.

No. 5000 SLRG

An extra margin of quality is designed and built into the complete line of McGILL industrial portable lamp guards for safe, dependable utility. Rugged, heavy duty construction and selected materials withstand the punishment of rough use. The famous McGILL LEVOLIER switch mechanism provides a degree of dependability not found in ordinary portables. It's economical to specify the best.

More than 100 different types of McGILL portable lamp guards have been developed to meet the particular requirements of a wide range of service conditions. Cages 50 to 200 watt. 660 watt, 250 volt sockets.

For detailed descriptions of the McGILL line of top quality electrial specialties, including portable lamp guards, and Levolier switches write for McGILL ELECTRICAL SPECIALTIES CATALOG No. 84.


LEVOLIER SWITCH AND SOCKET ASSEMBLY
APPROVED 3-WIRE GROUNDED CONVENIENCE OUTLET
SCREW SHELL .006" HEAVIER THAN STANDARD
IMPACT RESISTING MOLDED PHENOLIC PLASTIC HANDLE
RUBBER GASKET
STRAIN RELIEF CLAMP

No. 7100 SR Lamp Guard

Thumb clamp arrangement for cage to change lamps quickly without tools. Gray Neoprene-butyl handle; reflector; LEVOLIER switch.

No. 5025 SRG Service Light

Completely grounded service light. 15 amp., 125 volt convenience outlet built into molded phenolic handle. Safe on-the job source for power tools. Levolier switch and 25 ft. 16-3-SJ gray rubber cord.

No. 5000 SR Lamp Guard

With 15 amp., 125 volt convenience outlet in impact and heat and grease-resisting positively insulating molded phenolic handle. No-Rol cage, Levolier switch and reflector.

No. 3006 Vaporproof Lamp Guard

Watertight, vaporproof and moistureproof for complete safety. Heat and impact resisting glass globe screws into a silicone rubber gasket. Handle molded of macerated phenolic.

No. 652 Lamp Guard

Rubber hook handle, thumb release clamp for easy bulb replacement. Can be hung, for maximum light, from hook or handle.

Write for Free McGill Catalog No. 84

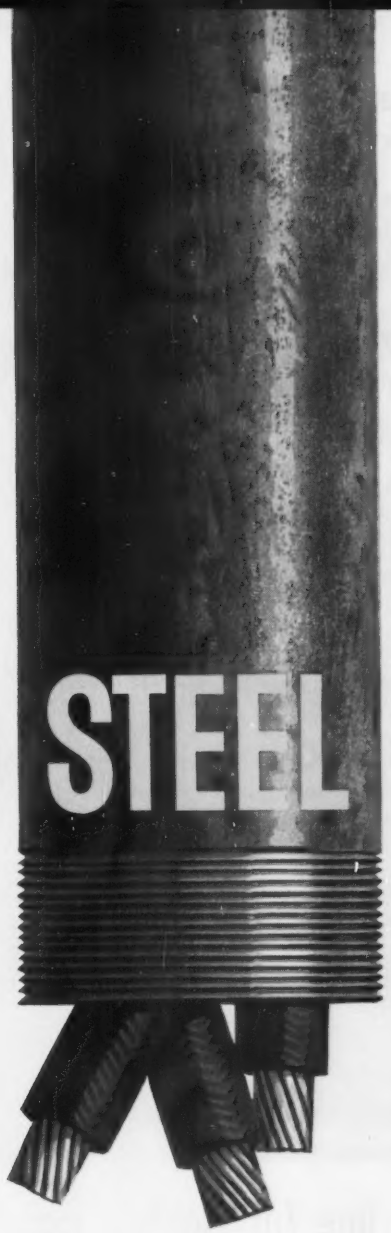
engineered electrical products

McGILL®

precision needle roller bearings

McGILL MANUFACTURING COMPANY, INC., ELECTRICAL DIV., 450 N. CAMPBELL ST., VALPARAISO, INDIANA

RIGID STEEL CONDUIT



protects electrical wiring permanently . . . guards against physical damage . . . combats the hazards inherent in any wiring system. After 50 years of service, rigid steel conduit is still the strongest answer to your electrical raceway problems.

Before you specify your next job, check with the leading manufacturers of steel electrical conduit, many of whom build their products from Bethlehem steel—EMT from Bethlehem steel sheet; rigid conduit from Bethlehem steel pipe. Or ask your electrical distributor for comparative details.

Steel

for Strength
. . . Economy
. . . Versatility

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

I'VE SEEN IT-YOU'LL LIKE THIS NEW LINE

General Electric's all-new line for electric comfort heating

"This complete line is tops in appearance, quality and easy installation. And when customers see that General Electric Monogram it sure helps close the sale," says Ollie Windhorst, owner, Reddy Electric Company, Inc., Louisville, Ky. Designed, engineered and manufactured by General Electric, the line includes:

THERMOSTATS—new beauty and compactness—blend with General Electric's popular decorator wall plates.

BASEBOARDS—new "square silhouette" styling. Linear thermal cut-out and General Electric Calrod® heating units are *standard equipment.*

WALL HEATERS—new clean design, efficient performance! Thermostatic control, whisper-quiet, brushless fan motor.

RADIANT HEATING WIRE—new machine spliced, factory-sealed leads for positive connection. Sturdy metal spool dispenser.

FREE LITERATURE: *for complete details, write 49-112-1, General Electric Company, Electric Comfort Heating Section, Appliance Park, Louisville 1, Kentucky.*

280-01

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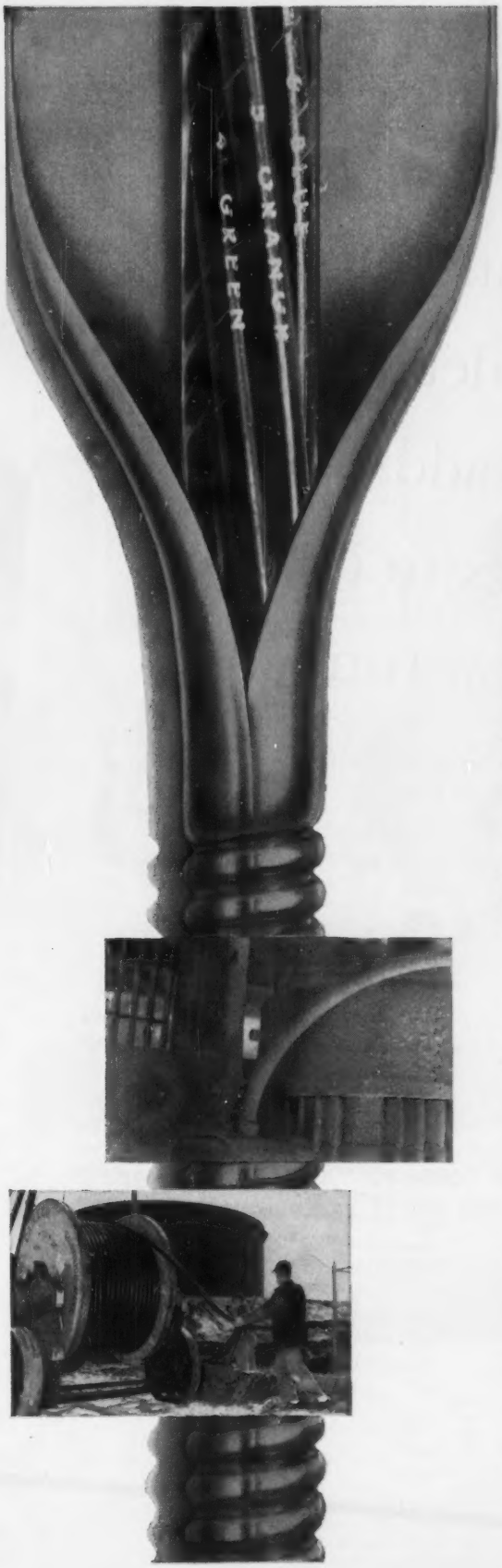


Only C-L-X®

Continuous Lightweight eXterior

Sealed Cable Systems by Simplex Can do so Many Jobs so Well

Simplex C-L-X is a packaged combination of cable and an extremely pliable, corrugated metal sheath. It requires no separate duct or conduit regardless of environment. It is available with steel sheath and plastic jacketing; and with copper or aluminum sheaths, with or without plastic jacketing.

C-L-X Cuts Installation Costs

By using a single length of 3-conductor 15KV C-L-X for both underground and aerial use, a Southeastern utility company saved more than 20,000 dollars from what it would have cost for a complete underground duct system.

Resists Chemical Attack

Conduit life in this company's calcium chloride reclamation building was only 6 to 9 months. The conduit was replaced with a C-L-X cable system which — after two years of operation, shows no signs of deterioration.

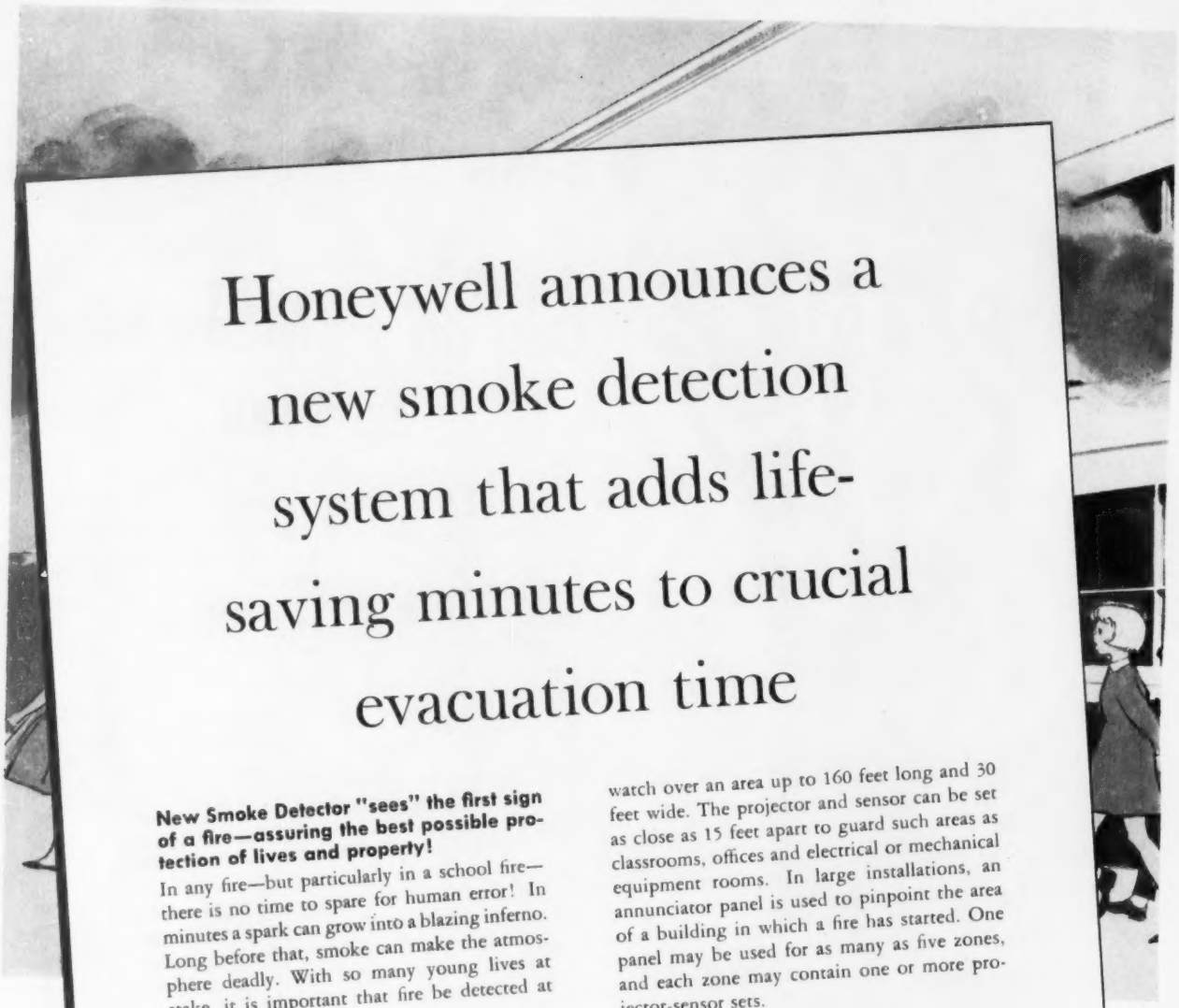
Protects Against Liquids and Gases

An East Coast petroleum tank farm used a C-L-X 8-conductor cable protected with PVC for direct burial in ground that was saturated with oil, gas and water. Result: Perfect performance at a sizeable savings over conduit systems.

Only Simplex C-L-X offers you: Exceptional Strength . . . Unequalled Pliability . . . Protection from Liquids and Gases . . . Faster Installation and Lower Costs. Send for Illustrated Brochure containing Application and Engineering Data.

SIMPLEX WIRE & CABLE Co

CAMBRIDGE, MASSACHUSETTS



Honeywell announces a new smoke detection system that adds life-saving minutes to crucial evacuation time

New Smoke Detector "sees" the first sign of a fire—assuring the best possible protection of lives and property!

In any fire—but particularly in a school fire—there is no time to spare for human error! In minutes a spark can grow into a blazing inferno. Long before that, smoke can make the atmosphere deadly. With so many young lives at stake, it is important that fire be detected at the earliest possible moment.

Now Honeywell has developed a new smoke detection system that *sees* the first sign of a fire—smoke—first. It saves valuable minutes. And these minutes saved can mean lives and property saved.

Compare, and you'll find Honeywell's new Smoke Sentry the fastest detection system available. It stands guard over large, open areas with a constant beam of light. When smoke interrupts this beam, an alarm sounds instantly. Even the tiniest wisp of smoke from a hidden fire will be *seen* and will trigger the alarm mechanism.

Never before, a smoke detector that safeguards an area the size of a basketball court—round-the-clock!

A single Smoke Sentry projector-sensor set will watch over an area up to 160 feet long and 30 feet wide. The projector and sensor can be set as close as 15 feet apart to guard such areas as classrooms, offices and electrical or mechanical equipment rooms. In large installations, an annunciator panel is used to pinpoint the area of a building in which a fire has started. One panel may be used for as many as five zones, and each zone may contain one or more projector-sensor sets.

It's the latest addition to Honeywell's complete fire alarm system for every building, every situation!

The Smoke Sentry can be used in addition to Honeywell's Fire Detection and Alarm System for total protection in critical areas. The combined systems offer four-way safety: fast automatic detection—manual stations—local alarm—and automatic calling of the fire department. For further information about the new Smoke Sentry, call your local Honeywell office. Or write Honeywell, Minneapolis 8, Minnesota. In Canada, write Honeywell Controls, Limited, Toronto 17, Ontario.

NEW RAY-OF-LIGHT SMOKE DETECTOR PROVIDES EXTRA LIFE-SAVING MINUTES

Honeywell

First in Control

SINCE 1885

HONEYWELL INTERNATIONAL
Sales and service offices in all principal cities of the world.
Manufacturing in the United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.

3 reasons why General Electric Slimline is America's most popular 8-foot fluorescent

Any time you see a long, unbroken line of fluorescent light, chances are good it's a General Electric Slimline lamp. Over the years, the G-E Slimline has proved . . .

1. *Your customers can cut parts maintenance almost in half.* A G-E Slimline system has about half as many parts as a standard 40-watt system, yet it produces the same amount of light.

2. *Your customers get 5% higher efficiency* from General Electric Slimline lamps than from standard 40-watt fluorescents. They get more light for every dollar of electricity.

3. *Your customers can make their places look better.* Slimlines start instantly, with no blinking. They have an excellent record of uniformity and long life because of General Electric's outstanding quality controls and manufacturing experience. Available in all popular colors.

There are 14 combinations of tube length and diameter to fit anyone's space requirements. Recommend General Electric Slimline lamps on your next job. General Electric Co., Large Lamp Dept. C-13, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC

The nearsighted MISTER MAGOO says . . . "1945? Who could forget that year? Eagle-eye Magoo was mustered out of the Aircraft-Spotting Command, and General Electric invented the slimline lamp. Happy birthday, Slimline! Zounds —they don't make these telescopes like they used to!"

Heavy-duty extensions...

Cornish, of course

In the shop or in the field—count on Cornish to furnish everything you need in heavy-duty extensions. You'll find Cornish heavy-duty cords with ratings to 600 volts, 10 amperes...lengths to 100 feet...molded-on connectors. Twistlock connectors give fast, safe, positive connection—can't be disconnected by accident. ◆ Need extra field outlets? Use Cornish "Y" and "W" junctions. Field lighting? String it in a flash with Cornish Lite-Line. ◆ Remember Cornish, too, for the only really complete lines of electronic wires, flexible cords and thermostat wires. ◆ For plug-in power—anywhere—call Cornish. Distributors are everywhere—coast to coast. Cornish Wire Co., 50 Church Street, New York 7, New York

CORNISH

BLASTING HAMMER STANDARDS WIDE OPEN!

FREE YEAR'S SERVICE -

You've heard B&D Hammers are tough! You've heard they're practically maintenance-free! Now Black & Decker *proves* its faith in these rugged tools with a certificate good for free service and parts for a year.

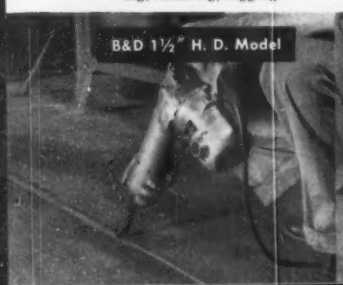
* **You don't pay a penny for normal maintenance during a whole year of operation, under the terms of the service certificate.**

There are other reasons why you should want Black & Decker hammering away at your jobs. Initial cost, for example. Check around and you'll find that Black & Decker Hammers cost less than other makes of the same capacity. Also you'll find the maintenance costs on B&D Hammers low in relation to output.

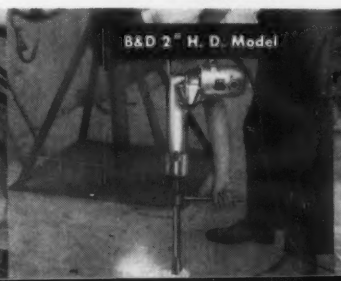
More reasons? Look to Black & Decker versatility

B&D HAMMERS COMBINE VERSATILITY WITH POWER TO GIVE YOU

Use B&D Hammers for channeling, chiseling, digging.

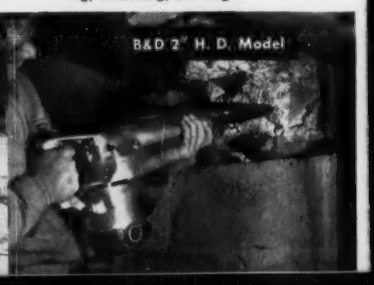


Use B&D Hammers for setting shields, drilling, piercing.



Use B&D Hammers for slotting, caulking, breaking.

Use B&D Hammers for smashing, battering, shaking.



ONLY BLACK & DECKER DARES OFFER

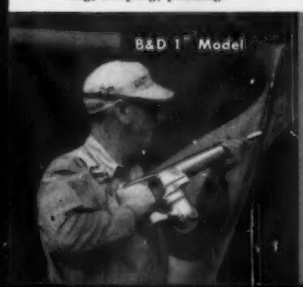
-ALL PARTS AND LABOR*

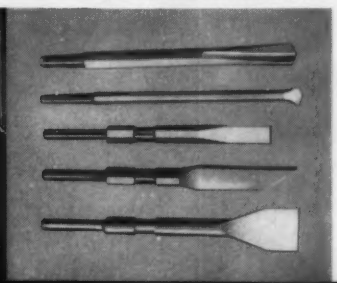
and power. Whichever of B&D's four hammer models and many accessories you need . . . whatever the job . . . Black & Decker's exclusive spring-and-compressed-air power transmission delivers tremendously effective IMPACT per blow for faster work, better work. Ask now about the free service certificate with B&D Hammers. Sold by leading distributors everywhere.

MORE WALLOP, MORE WORK!

Use B&D Hammers for cleaning, shaping, peening.

Use B&D accessories designed especially for B&D Hammers.





For Black & Decker sales or service, look in the Yellow Pages of your telephone book under

TOOLS ELECTRIC

Black & Decker®

CUTS MAN-HOURS TO MINUTES

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Towson 4, Md.

☐ Please send me 20-page hammer handbook

☐ Please arrange for a demonstration of.....

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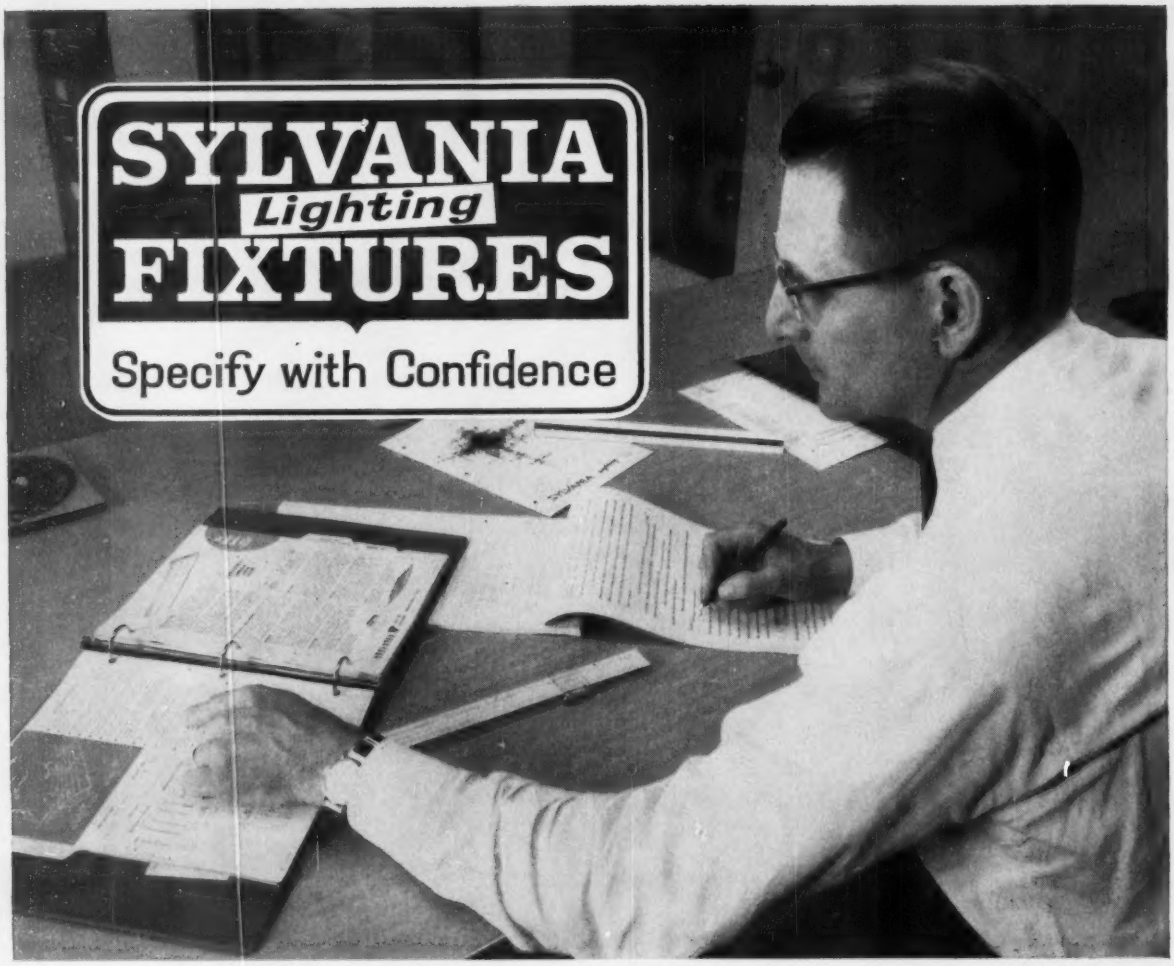
City.....Zone.....State.....

☐ Drills ☐ Sanders ☐ Impact Wrenches ☐ Vacuum Cleaners



You have everything you need when you include Sylvania Fixtures in your lighting specifications:

- A wide selection of commercial and industrial fixtures to fit in with any type building.
- 2 basic ceiling lighting systems with many variations to suit individual preferences.
- Extremely flexible line of shallow recessed and Air-Handling Troffers.
- Reliable performance based on 22 years' experience in fluorescent fixture research, design and manufacturing.
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a feature of the new

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also **CUTS WIRE**
STRIPS WIRE
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Buy your Hylugs and Hylinks in Burndy's handy new FLIP-TOP BOXES—the best way to keep them in your kit...the best way to use them on the job!

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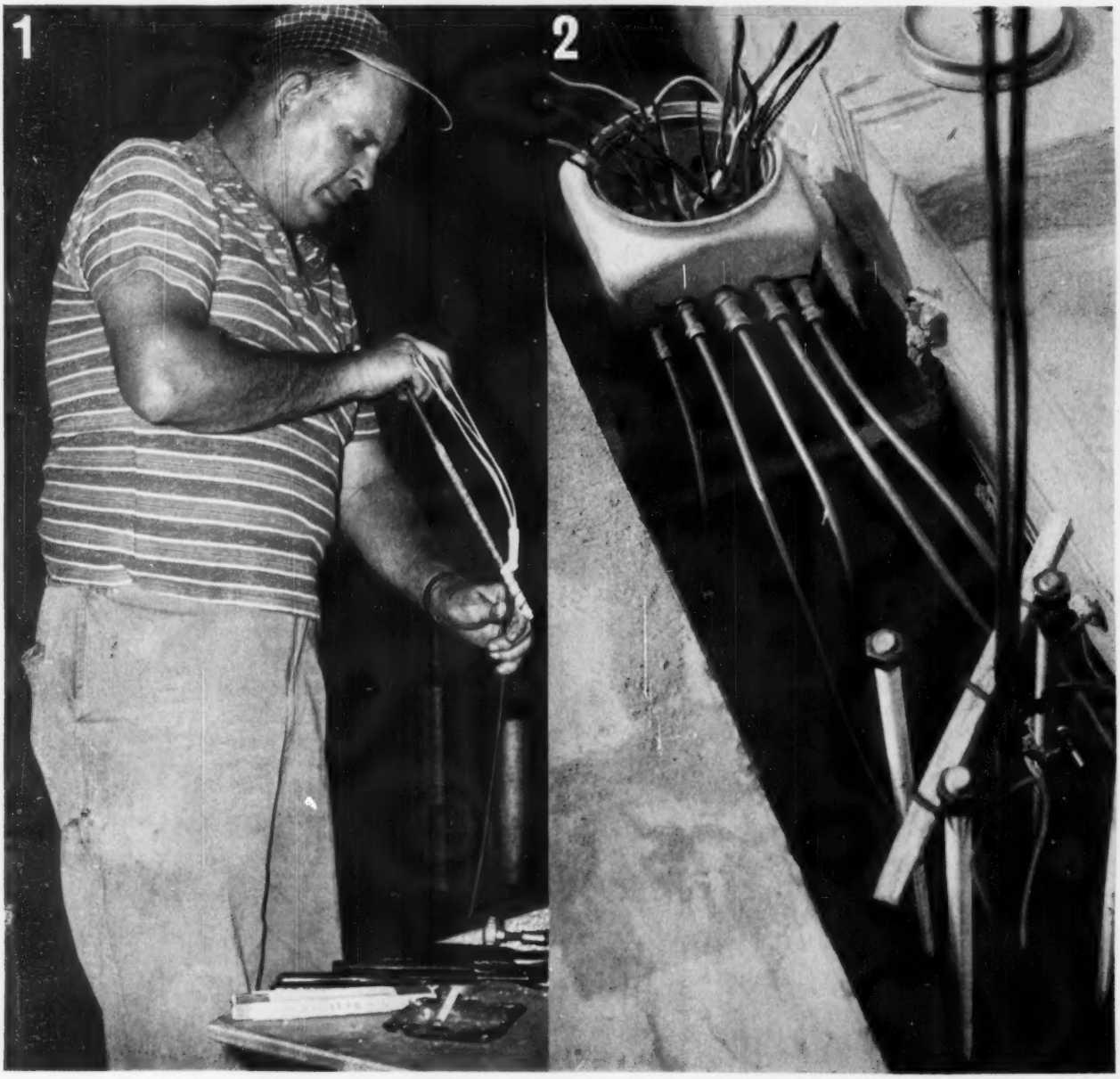
BURNDY

58-6

Good contractors install MI

No other cable offers the speed, the economy, the safety that Mineral Insulated Cable gave to this service station remodeling...No other cable fits such a wide variety of 600-volt-and-under applications...No wonder more and more

1 Stripping MI Cable for termination. Next: lay cable, make junctions—and you're done! **2** MI leaves explosion-proof junction box. Bends and offsets are hand-made—without a hickey. **3** Sand-filled breakaway service station island being rewired with MI. Rugged, solid MI virtually eliminates problems of moisture, freezing, explosion. It is rigid—stands free as shown...but so flexible a free length remains in pump base, permits easy offset to junction box regardless of location. **4** MI Cable meets pump junction box. Termination is Type H—special for hazardous locations.

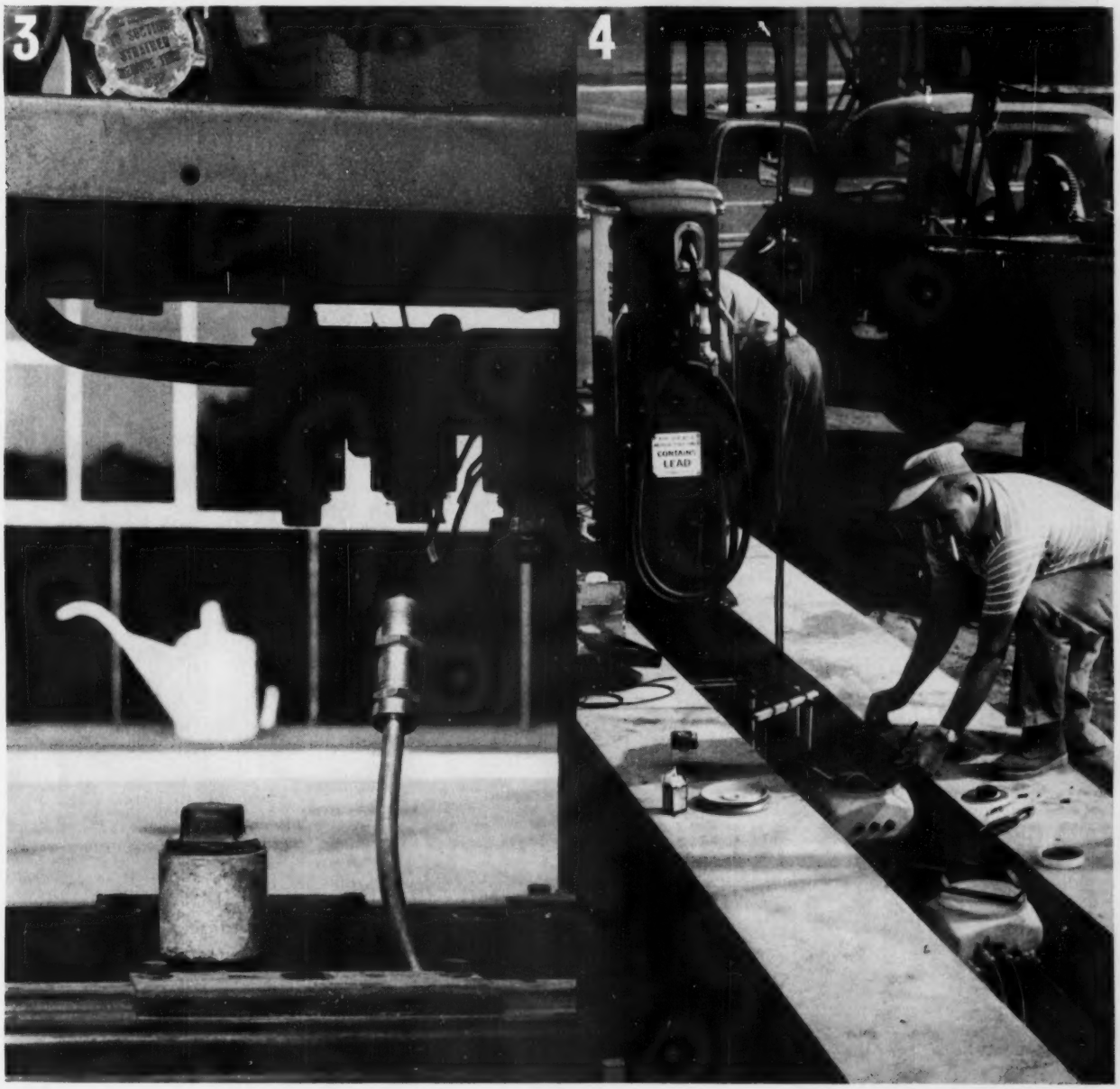


Cable for service stations, too

contractors bid more and more jobs on the basis of MI Cable! Be sure you have on hand all the latest MI information. Write General Cable for your copy of Catalog S-2. General Cable Corporation, 730 Third Avenue, New York 17, New York

HERE'S WHAT MI CABLE MEANS TO YOU: SAVES TIME Just train cable from power to use, and terminate. That's all! **EASY TO USE** because MI is lighter, more flexible, about half the OD of equivalent conduit. **FLEXIBLE — RIGID** Train MI by hand — it keeps its professional look with few supports. **RESISTS HEAT** Continuous use: 185°F... special applications: 482°F... short duration: up to melting point of the sheath. **RESISTS MOISTURE, VAPOR** Liquids and gases can't pass along MI's solid core, nor penetrate its sheath. **NEC APPROVED** for general use in Article 500 of Amended 1956 NEC. Many other regulating bodies have approved MI, including for use in hazardous locations. **WIDE VARIETY** Comes in 1, 2, 3, 4, and 7/C — in all regular AWG conductor sizes.

GCC
GENERAL CABLE CORPORATION



TWO HANDS

Can Make MORE PROFITS

With BRIEGEL

Indenter Tools and Fittings

There are but few products with which you can do a better job in less time at lower cost.

Used together, Original B-M Indenter Fittings and Tools will do just this and increase your profits from each installation.

BM-51
½" Offset Connector
BM-52
¾" Offset Connector

BM-41
½" Coupling
BM-42
¾" Coupling
BM-43
1" Coupling

Red Throat
BM-21B
½" Connector
BM-22B
¾" Connector
BM-23B
1" Connector

ALL BRIEGEL FITTINGS ARE U. L. APPROVED AS CONCRETE-TIGHT

BRIEGEL METHOD TOOL CO.

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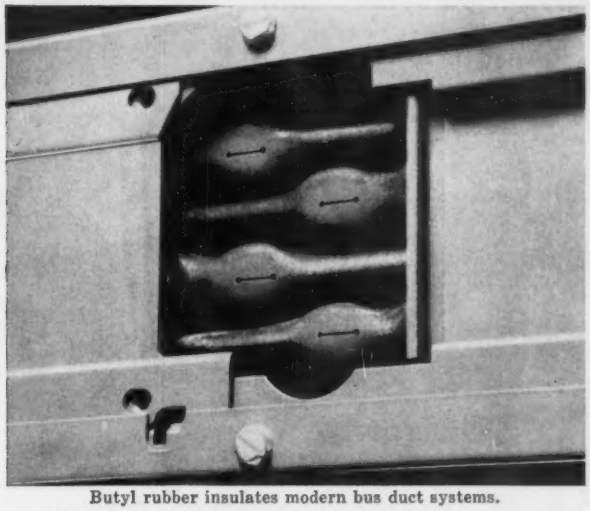
All B-M indenter type fittings far exceed the requirements of U. L. file card E 10863 and Federal Specifications W-F-406.

TELESCOPE BM SYSTEM

USED THE MOST FROM COAST TO COAST

Butyl rubber insulates modern high-voltage transmission lines.



Butyl rubber insulates modern bus duct systems.

Butyl rubber insulates modern high-voltage transformers.

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best way to handle electricity

Enjay Butyl tops all vulcanizable rubbers in electrical and dielectric properties . . . in resistance to corona and ozone breakdown and water absorption. Its high dielectric strength insures against electric breakdown under normal or surge voltage. Its heat resistance permits higher current flow for a given conductor size. Butyl also offers outstanding resistance to weathering and sunlight . . . chemicals . . . abrasion, tear and flexing . . . superior damping properties ...unmatched impermeability to gases. Result? Butyl is ideal for wire and power cable, transformers, tapes, bus bars, and other insulation applications.

Find out how this versatile rubber can improve your product. Contact Enjay at 15 West 51st Street, New York 19, N. Y. Enjay does not make insulation. It supplies Butyl rubber to manufacturers of scores of different electrical products.

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ENJAY CHEMICAL COMPANY

A DIVISION OF HUMBLE OIL & REFINING COMPANY

ENJAY® BUTYL

Westinghouse delivers dependable power to first automated U.S. Post Office

(Below) Functional, clean lines of the Providence Post Office exterior are highlighted by Westinghouse OV-25 parking area luminaires, assuring 24-hour maximum security operation. The luminaires' horizontal housing and tilted optical system are completely sealed against dirt, moisture and bugs for years of low maintenance, high efficiency operation.

J-94161-1

The nation's first automated post office, labeled "Project Turnkey," is operating now in Providence, R.I. It represents the first step in the government's plan to make the complexity of mail handling completely automatic to insure 24-hour delivery of mail to any part of the country.

Behind the architectural beauty of this $20,000,000 facility is a vital electrical nervous system. And it's the sure, steady performance of Westinghouse electrical apparatus that keeps this marvel humming.

From dependable, maintenance-free outdoor luminaires that light the 14-acre site to 69 power and lighting panelboards that feed sensitive letter sorters, facing and cancelling machines, parcel post machine and conveyor system, Westinghouse products coordinate for the high degree

(continued on next page)

These 11 sorters distribute mail to bins for 300 separate destinations after an operator's key punch code has sent an impulse to the memory unit of the sorter. Other major machines in the system are six letter cullers, six facer-cancellers, two parcel post sorters, and over three miles of conveyors.

Owner: Intelex Systems, Inc. Architect-Engineers: Charles A. Maguire and Associates, Providence, R.I. General Contractor: Gilbane Building Company, Providence, R.I. Electrical Contractor: Brady Electrical Company, East Providence, R.I. Westinghouse Distributor: WESCO, Providence, R.I.

(continued from preceding pages)

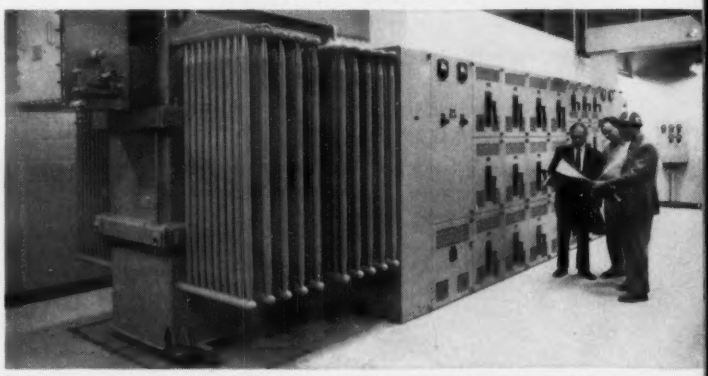
of service so important to this "Post Office of Tomorrow." It is estimated that 10,250,000 kilowatt hours of electrical energy will be required annually for the 24-hour operation of the plant.

The Gilbane Building Company, Providence, erected the structure for Intelex, a subsidiary of International Telephone & Telegraph, who will lease it and its mechanized mail processing equipment to the government for 20 years. Design was by Charles A. Maguire and Associates, Providence. Westinghouse personnel worked closely with the consulting engineer from design stages through completion. Experience and the completeness of the Westinghouse line earned this working role in mail handling history.

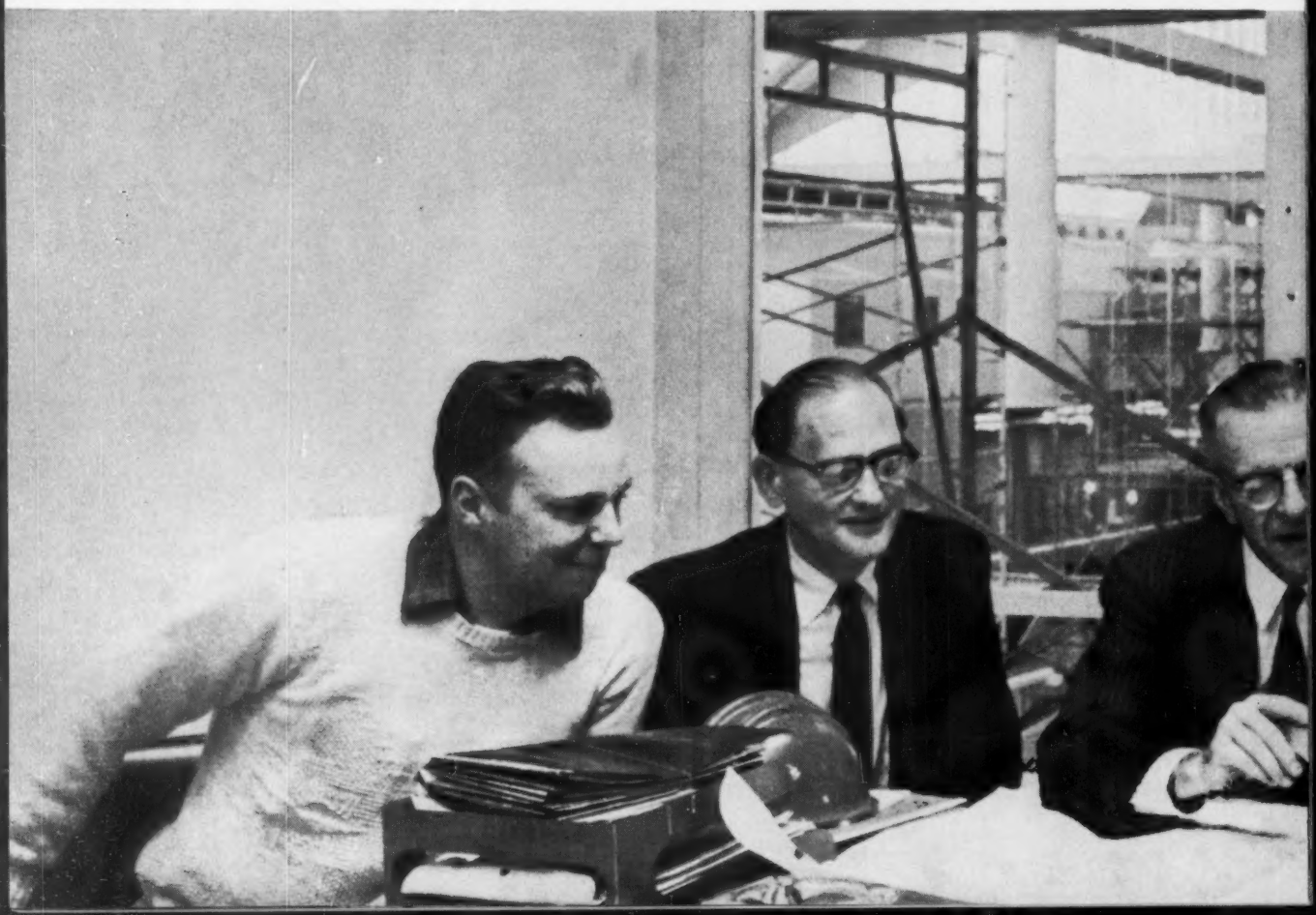
You can be *sure* . . . if it's Westinghouse!

(Below) Reviewing drawings during the construction of Project Turnkey are, left to right: Arthur A. Watson, General Foreman, Brady Electrical Co., Inc.; A. I. Israel, Charles A. Maguire and Associates; E. Howard Rohrbach, Project Manager, Intelex Systems; Richard F. Martin, Project Manager, Gilbane Building Company; R. W. MacArthur, Westinghouse; and Walter W. Botts, Manager WESCO, Providence.

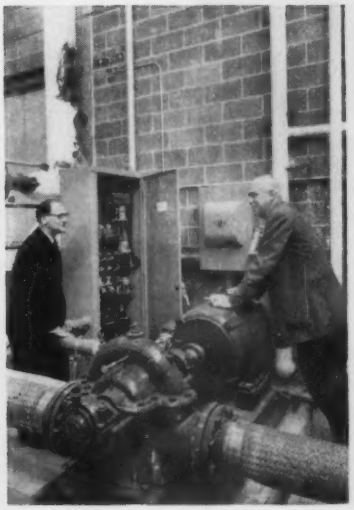
(Above) Rugged, weatherproof enclosure shields Westinghouse 150-DH-250 air circuit breakers which protect main feeders providing power to the post office. Inspecting breakers are A. A. Watson, W. W. Botts, R. W. MacArthur, and A. I. Israel (kneeling).



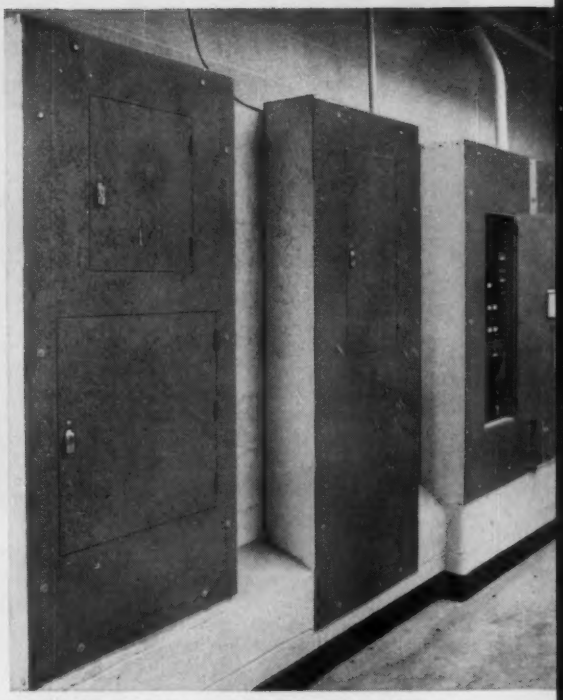
This main substation, rated 2500 kva, provides reliable source for lighting and power circuits. It receives incoming power at 11 kv directly from outdoor metal clad switchgear. Discussing schematic drawings of power circuits are: A. I. Israel, A. A. Watson and R. McCloskey, Resident Engineer, Charles A. Maguire and Associates.



(Above) A. I. Israel operates remote circuit breaker control panel for 15 kv outdoor metal clad switchgear as R. W. MacArthur looks on. Switchgear furnishes incoming power safely and efficiently to Westinghouse 500 kva power center serving post office auxiliaries. Compact design permitted location in minimum space, freeing valuable footage for work areas.



A. I. Israel, left, and W. W. Botts discuss operation of electrical system in mechanical building. In foreground is a 60 hp, 208 volt drip-proof Westinghouse motor, driving a chilled water pump. 400 amp safety switch on wall feeds an autotransformer reduced voltage starter which cushions inrush current to assure smooth pump start-up.



Westinghouse CDP power distribution panelboards equipped with De-ion® circuit breakers control and protect feeder circuits supplying power to intricate mail handling equipment. Complex systematized handling system requires reliable power supply since local failures would seriously impair movement schedules. Famed De-ion principle of arc quenching assures maximum circuit breaker life by preventing burning and pitting contacts.

Westinghouse

J-94161-2

Los Angeles
International Airport
Los Angeles, California

Architects and Engineers: Joint venture for the Los Angeles Department of Airports by
Charles Luckman Associates
Los Angeles, California
and
Welton Becket & Associates
Los Angeles, California
and
Paul R. Williams & Associates
Los Angeles, California

Electrical Engineer: J. S. Hamel Company
Burbank, California

Contractor Fischbach & Moore
Los Angeles, California

Penn Square Shopping Center
Oklahoma City, Oklahoma

Architects: Sorey, Hill and Sorey
Oklahoma City, Oklahoma

Contractor: Manhattan Construction Company
Oklahoma City, Oklahoma

Thank You Gentlemen

We are proud that Ideal Wing-Nut connectors have been selected for making branch circuit and fixture wire connections on your projects.

Leading architects and contractors everywhere are using the Wing-Nut for several important reasons:

More U. L.-approved combinations than any other screw-on connector: 474 solid and/or stranded copper wire joints, and every common aluminum-to-aluminum combination.

Unique wings provide a natural, powerful grip. This built-in wrench design makes Wing-Nut twice as easy to screw on as any other connector.

Nylon shell has deep, wide skirt to easily handle even thick type RHW insulated wires. You can actually see your splice is tight through the semi-transparent shell.

Wing-Nut makes the safest, strongest, tightest, fastest, most shake-proof screw-on wire connection possible.

This is why more and more prestige buildings have *all* electrical splices made with Wing-Nut. See for yourself. Write for free samples of both sizes and technical literature.

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1041-D Park Avenue, Sycamore, Illinois

Sold through America's leading Distributors
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Architect and Engineer: Claud Beelman & Associates
Los Angeles, California

Electrical Contractor: Ling-Oliver Electric, Inc.
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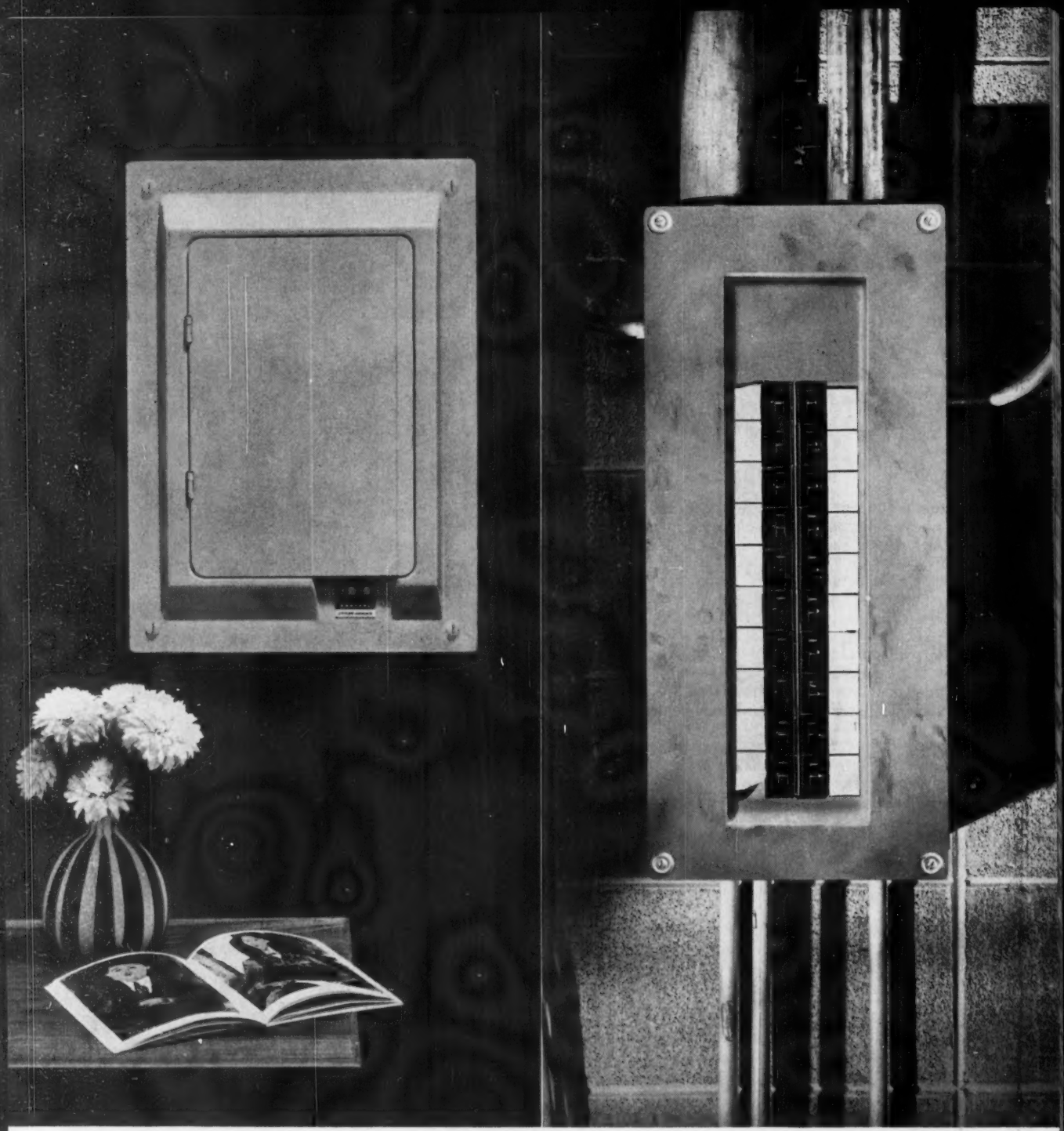
Capehart Housing Project for United States Air Force
Omaha, Nebraska

Architects: Steele, Sandham & Weinstein
Omaha, Nebraska

Engineers: Henningson, Durham & Richardson
Omaha, Nebraska

Contractor: Modern Electric Company
Omaha, Nebraska

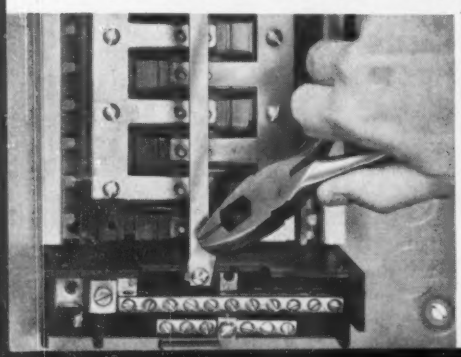


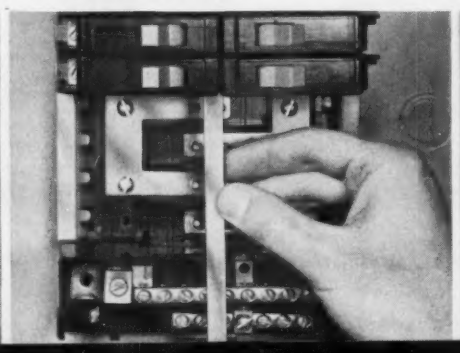
SIMPLEST, MOST FOOLPROOF N. I. SYSTEM BY FAR—NO SPECIAL TOOLS REQUIRED FOR INSTALLATION Simplified Safetybreaker system eliminates fussy keying systems, makes it impossible to incorrectly position tabs. Here's the Safetybreaker method:

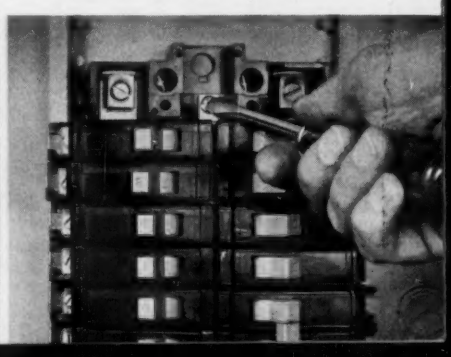
1 Simply tear off soft plastic spacers to loosen locking-bar screws, and let locking bar drop.

2 Plug in breakers in top portion of panel. Slide bar to top of panel.

3 Plug in remaining breakers. Tighten two screws to lock the NI system.







Why settle for an old-fashioned "basement gray" box?

Get this new, smartly-styled safetybreaker...it doesn't cost a nickel more

(and often costs less!)

Here's a bonus in beauty and protection that gives you—and your customers—extra features at no extra cost.

Modern appliance styling lets you show how good your wiring job is. This soft sandalwood finish *belongs* upstairs, convenient to the kitchen, saving you on those heavy wiring runs.

Eliminates housewife confusion and saves you unnecessary call-backs. Simple as a light switch, with easy-to-see "on" and "off" positions. There is no tripped mid-position to harass the homeowner, no calls for you to reset the breaker because the housewife mislaid or misread instructions.

Inside as superior as the outside. Won't rust, won't corrode because every operating part is either stainless steel or heavily plated. Double protection with magnetic trip for short circuits *and* bimetal trip for sustained overloads. Easier to install with plenty of wiring room, no knuckle-skinning wire guides.

Want to know more about Cutler-Hammer's New Safetybreaker? Write for free 36-page Safetybreaker Selection Guide. Better yet, see your Cutler-Hammer distributor and let him show you personally.

What's new at Cutler-Hammer? This new Safetybreaker is typical of the *better* products you'll be getting from Cutler-Hammer . . . results of new engineering talent . . . new facilities . . . a new creative atmosphere at every level.

WHAT'S NEW? ASK...

CUTLER-HAMMER

Cutler-Hammer Inc., Milwaukee, Wisconsin • Division: Airborne Instruments Laboratory • Subsidiary: Cutler-Hammer International, C. A. Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A.

JOB-PROFIT TOOLING IDEAS

FROM GREENLEE

New lightweight Wire Puller for fast one-man operation

- **WEIGHS ONLY 29 LB**
- **TWO-SPEED WINCH . . . 3 TO 1 AND 9 TO 1 RATIOS . . .**
- **PATENTED RATCHET ACTION**

Easily carried and operated by one man, the new GREENLEE No. 766 Wire Puller requires only 30-lb handle pressure to pull 1500 lb. Wire can be pulled at any angle from large or small outlet boxes or from the end of exposed conduit. At all times the pull is in line with the conduit . . . no strain on the hanger or outlet box. No loose cable to contend with . . . reel holds 200 feet of aircraft steel cable. Patented winch ratchet action . . . open-side pulley support for easy access to any outlet box. Typical performance: Large Midwest contractor reports pulling four strands of 4/0 wire through 165 feet of 2½-inch conduit with two 90° bends. Time, *20 minutes.*

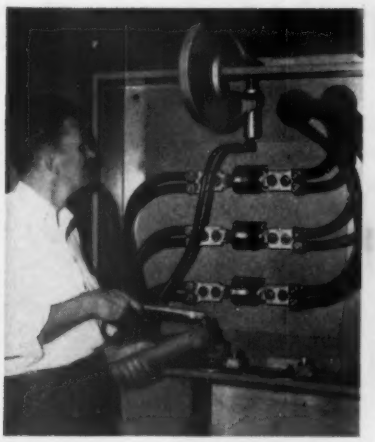
For large-size cable pulling use Greenlee No. 765 Cable Puller

ONE-MAN OPERATION • 7500 LB PULL • TWO OPERATING SPEEDS

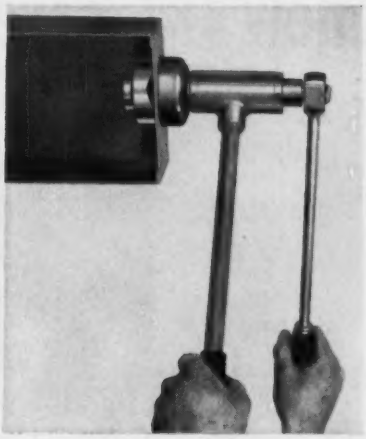
Portable . . . easy to set up and operate. Use it on exposed or concealed conduit. Pull is in line with the conduit with no strain on the hangers or outlet boxes. Can be equipped with flexible elbow attachment for pulling from concealed conduit . . . permits placing puller at any desired distance from end of conduit.

Hand and power drivers for knockout punches

Greenlee No. 7646-A hydraulic knockout punch driver develops 11 tons' ram force to easily drive punches through 10-gauge metal . . . cuts ½″ thru 5″ conduit openings in seconds. Many times faster than wrench method . . . can be used in cramped quarters. Timesavings quickly pay for this efficient tool. Designed to drive all Greenlee knockout punches. It is available singly for punches already owned or is available in sets with 6 or 10 punches.

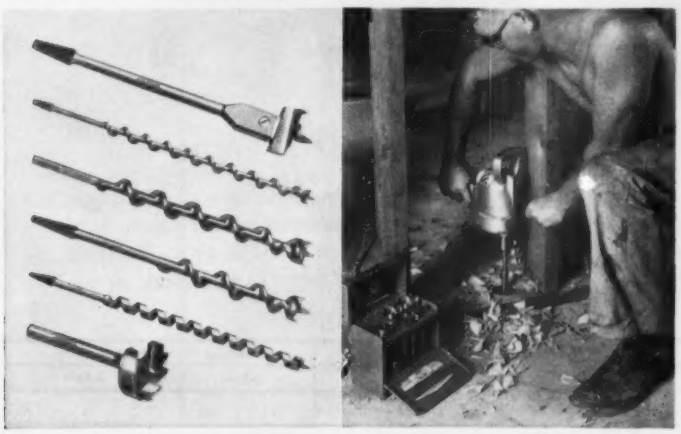


Greenlee one-shot knockout punch drivers are fast, lightweight, and powerful . . . easily operated by one man. Require no pre-drilling or step-up punching to make conduit openings . . . high-strength aluminum "C" frame. Punch cuts through 10-gauge steel with ease. Two sizes: No. 1731 to punch holes for ½″, ¾″, 1″ conduit and No. 1732 to punch holes for ½″ thru 4″ conduit. Hand or power pump operated.



Greenlee ratchet knockout punch driver makes conduit openings 6 to 8 times faster than with wrench method. Easily operated in any position. Use with standard Greenlee knockout punches from ½″ thru 3″. Available singly or with set of punches for ½″ thru 2″ conduit.

Greenlee makes a complete range of knockout punches for 1/2″ thru 5″ conduit . . . fast, easy cutting through 10-gauge metal . . . clean, accurate holes.

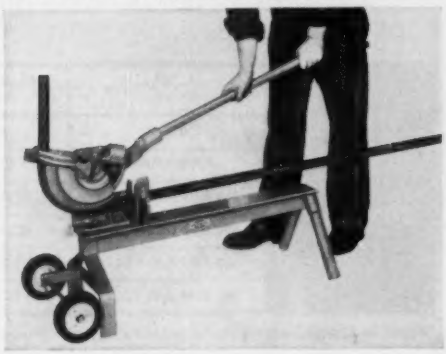


Fast-boring Greenlee bits for electrical work

Jobs go smoother when you standardize on Greenlee precision-made boring tools. Power drill and hand brace types . . . various styles and lengths for all types of electrical work. Electricians' auger bits, bellhangers' drills, solid-center auger bits, expansive bits, ship augers, pipe bits, spade-type power bits. Highest quality for fast, accurate boring and long life under hard usage.

Hand ratchet benders

Fast, easy way to make bends up to 90° in ½″ thru 1½″ rigid conduit. Greenlee ratchet bender is self-contained and easily portable. Ratchet action for short, powerful strokes . . . easy-to-reach ratchet release . . . built-in 0° to 90° bending gauge . . . swing-away pipe clamp for easy removal of 90° bend . . . direct handle operation for quick bending of small pipe. No. 1800 for ½″, ¾″, 1″ conduit. No. 1801 for 1¼″ and 1½″ sizes.



WRITE FOR CONDENSED CATALOG E-240A. GREENLEE TOOL CO., 1954 COLUMBIA AVE., ROCKFORD, ILLINOIS

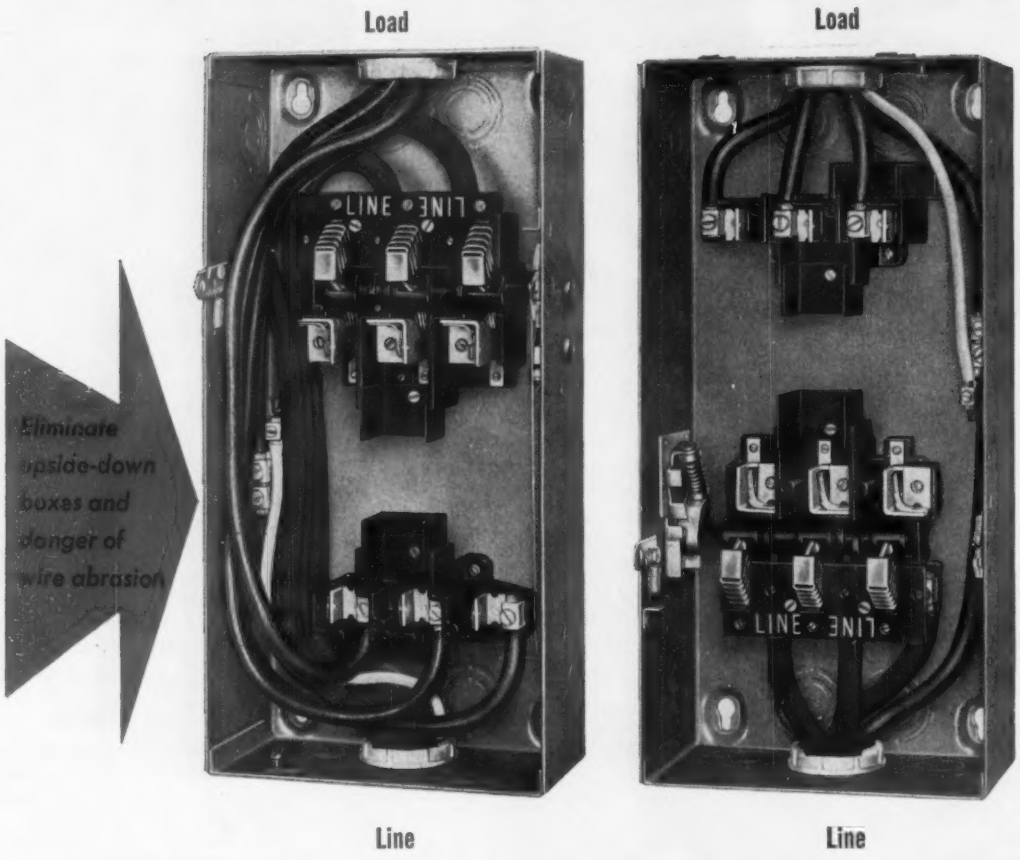
TOOLS FOR CRAFTSMEN

GREENLEE

JOB-PROFIT TOOLING

. . . cost control for contractors

Save up to $30 on cable cost with new G-E reversible-wiring safety switches



Old way wastes wire, work and money. Looped cable inside box presents danger of wire abrasion. None of this is necessary when you use new General Electric reversible-wiring safety switches, 100-amp and above.

New G-E way eliminates danger of wire abrasion, inconvenience of upside-down boxes. ON-OFF indication remains unchanged. Available with line lugs factory-installed at bottom, or for field installation.

SCHEDULE OF SAVINGS ON CONDUCTOR COSTS

Switch Rating	Conductor Size	Amount Saved Per Switch Installed*		Length of Wire Saved (In Feet)	
		2-Pole	3-Pole	2-Pole	3-Pole
100 AMP	2	$ .91	$ 1.36	5	8
200 AMP	3/0	3.73	5.60	9	14
400 AMP/240 VOLT	500 MCM	12.56	18.90	11	16
400 AMP/600 VOLT	500 MCM	13.74	20.60	12	17½
600 AMP/240 VOLT	(2) 350 MCM	18.70	28.10	22	33½
600 AMP/600 VOLT	(2) 350 MCM	20.40	30.60	24	36½

*Based on approximate contractor prices for Type RHW copper building wire.

GENERAL ELECTRIC

Circuit Protective Devices Dept., Plainville, Conn.

60TH YEAR • APRIL, 1961

ELECTRICAL CONSTRUCTION AND MAINTENANCE

Gas Energy Systems

An all-gas energy supply system is now in operation in a shopping center in Little Rock, Ark. Several school buildings now under construction in Texas include all-gas energy systems for which the engineers claim substantial economies in initial and operating costs. Favorable gas rates and novel engineering treatment are combined to produce fully air-conditioned buildings at lower cost than conventional non-air-conditioned construction.

Design of the mechanical and electrical system centers on the use of gas turbines, stationary versions of the aircraft turbo-prop jet engine, as prime movers for electric generators. Heat from the exhaust gases is captured in a low-pressure steam system supplying building heating, or cooling through an absorption chiller, and central hot water supply.

In practical application, several turbine-generator sets are operated in parallel to accommodate varying load requirements and to provide for shut down for routine maintenance and overhaul. Very long continuous duty service life is expected of the gas turbines when fueled by natural gas as they have few wearing parts or critical tolerances.

On-site generation of electric power in buildings at costs directly competitive with purchased power has not been notably successful in recent times. Utilities can operate at efficiencies impossible in small, isolated plants and they serve widely diversified loads. Thus the economics of on-site electric power generation depend upon by-product services to which a substantial part of the capital and operating costs can be allocated. In the all-gas system, heating, hot water and cooling are, to some degree, a by-product of electric power generation.

The new system is bound to arouse much interest, particularly where natural gas is abundant and cheap. The opportunity to produce electricity, economically, on site, at any voltage or frequency desired will appeal to many engineers. But, basically, it is still a central boiler room approach to energy application with all of the traditional problems of administration, supervision, upkeep and maintenance.

The trends of electrification on the other hand, are moving inexorably toward eliminating the central boiler room concept. Electric heat is easily dispersed through the building. Simple electric water heaters are efficiently applied in the immediate areas of use. Compact unit air conditioners can do an effective job of cooling without central apparatus. And utility electric power is usually abundant, reliable and reasonable in cost.

The challenge of the gas energy system cannot be dismissed lightly. It is sophisticated and ingenious. It emphasizes the vital necessity of pressing the total energy approach to building electrification. Historical trends favor all-electric energy systems, but it is still going to take bold design and vigorous selling to meet increasingly aggressive competition.

Wm. T. Stuart

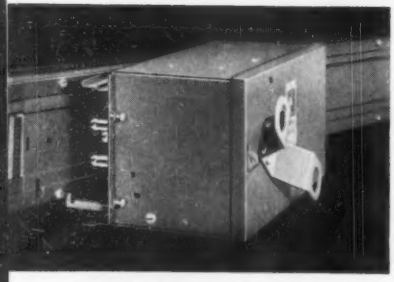
KNOW YOUR SYMBOLS

This symbol stands for bus duct

This symbol stands for QUALITY

XL Bus Duct by BullDog

Makes light work of installation four ways!



PLUG-IN SAFETY—Self-supporting XL Safety Plug hooks to duct, leaving workman's hands free to complete electrical plug-in with utmost ease and safety.

1 *Keyed ends* of plated aluminum bars align automatically, join as fast as sections can be handled.

2 *Single integral bolt* spins tight quickly to secure bars under a ton of pressure. Captive screws join casings together.

3 *New* HANGFAST *Adapter* bolts to suspension rod fast ...duct with standard hanger is instantly hooked and secured.

4 *Lightweight*, rigidly-made 10-foot sections require only *half* as many hangers as ordinary duct.

BullDog, the creator of plug-in bus duct, has for years assisted industrial plant operations by providing high performance, efficiency, flexibility and dependability in power distribution. Then BullDog went one step further . . . developed XL BUStribution® Duct to make installation and handling easier than ever before, as shown above. At the same time, BullDog incorporated foolproof dead-front safety as well as other features ensuring that workmen plug in for power the safe way *only!*

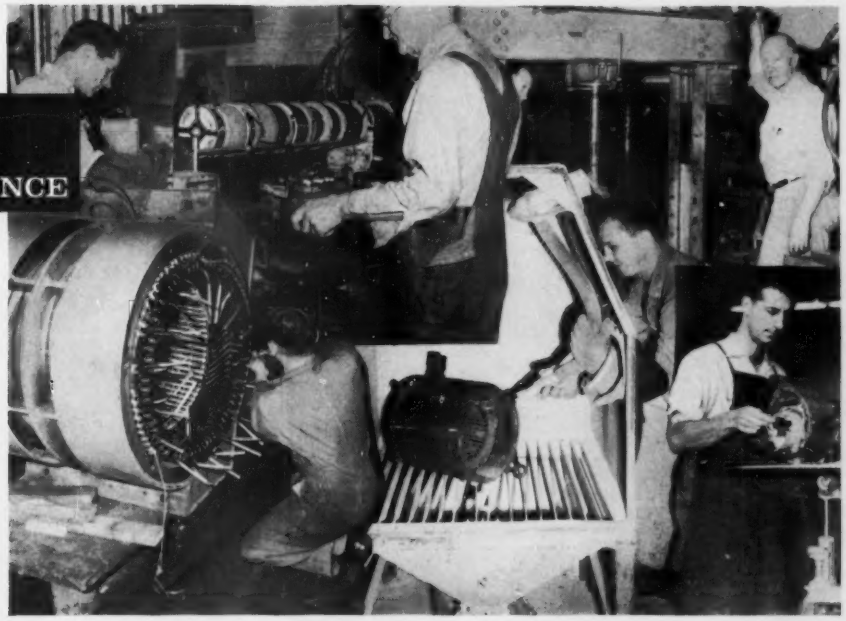
Ask your BullDog representative to show you all these XL Duct installation and safety advantages. He can also provide complete information about BullDog BD plug-in duct, LO-X® plug-in duct and LO-X feeder duct.

BullDog Electric Products Division, I-T-E Circuit Breaker Company, Box 177, Detroit 32, Mich. In Canada: 80 Clayson Rd., Toronto, Ont. Export Division: 13 East 40th St., New York 16, N.Y.

I-T-E CIRCUIT BREAKER COMPANY

BULLDOG ELECTRIC PRODUCTS DIVISION

ELECTRICAL CONSTRUCTION AND MAINTENANCE

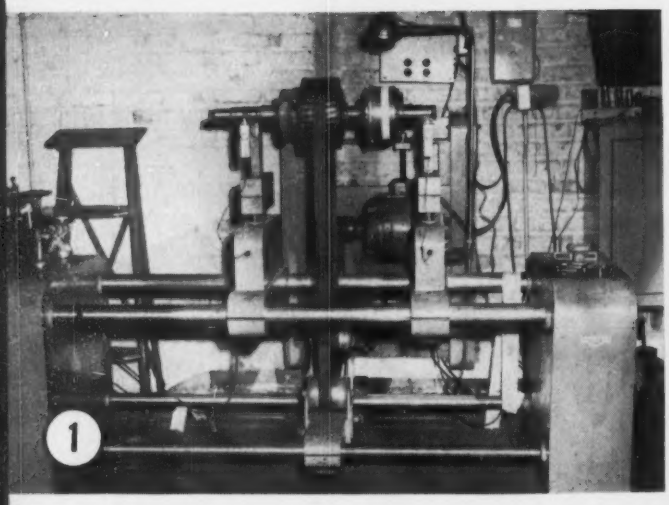


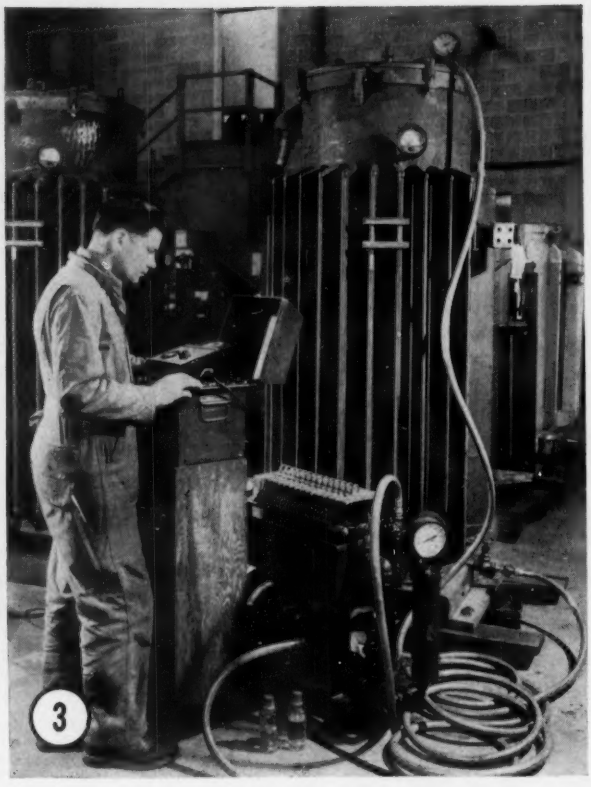
San Francisco Shop Practices

A roundup of practical methods used in shops located in and around San Francisco —host city for this year's EASA convention.

THIS coming June, motor and transformer men from all parts of the country will convene in San Francisco's modern Jack Tar Hotel to attend the 28th annual meeting of the National Industrial Service Association. Henceforth this organization will be known as the Electrical Apparatus Service Association, thereby defining its scope and purpose more specifically. Yet in spite of a new name, this long-established industrial service organization will retain such old characteristics as practical know-how, integrity, competence and business ethics. Convention delegates will again discuss such old subjects as customer service, public responsibility, management and organization problems, although these old topics will be re-slanted to reflect the impact of new technology, new materials, new methods and new markets. And, also following established precedent, local member shops will open their doors and books to Bay Area visitors, thereby demonstrating a sincere inter-industry spirit of cooperation which is no mere gesture or idle phrase.

Since many Bay Area shops are closely located to this year's convention center, delegates may conveniently compare winding practices and oven construction, dynamic balancing techniques and high-temperature insulations, materials-handling methods and transformer reconditioning, sales promotion methods and bookkeeping practices. These comparisons will reveal a representative cross-section of progressive shop practices.





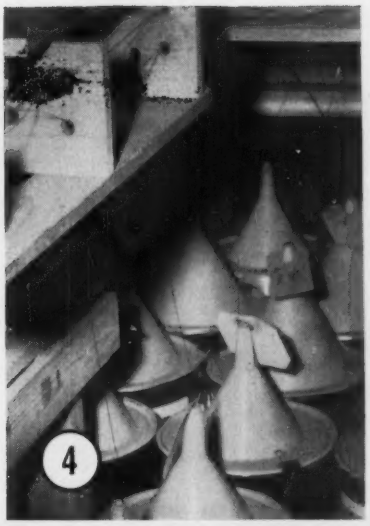
1. Believing that unbalanced rotating elements can lead to premature vibration, bearing deterioration and maintenance headaches, **Standard Electric and Engineering** of San Francisco tests all armatures, rotors, flywheels, fans and other rotating components on a dynamic balancing machine. Incorporating an adjustable-speed drive motor which may be raised or lowered on its vertical bedplate by means of a wormgear assembly, the machine can obtain varying rotational speeds and belt pressures, while a strobe light synchronized to and triggered by vibrating spring-mounted journals will locate and indicate precisely any out-of-balance point on assemblies being tested.

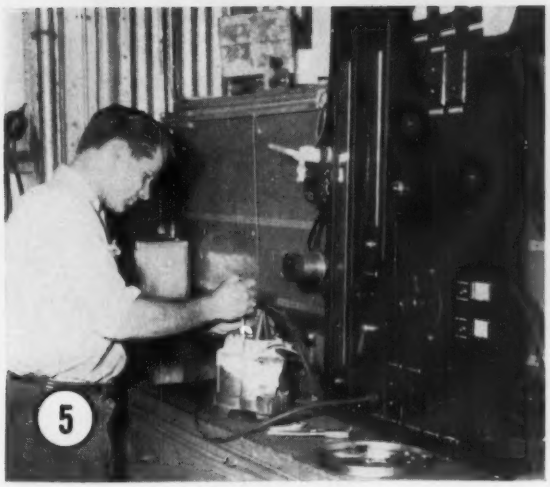
In this procedure, motor speeds may be varied by pressure upon either Fast or Slow pushbuttons; then stabilized at that desired speed by releasing the button in question. Point of unbalance is detected by means of a numbered tape wrapped around the rotating equipment being checked, while correction of weight distribution may be determined experimentally by applying lumps of duct-seal until perfect balance results. When this condition is obtained, temporary weight is replaced by permanent metal.

2. **Atlas Electric and Engineering Co.**, located in San Francisco, does a sizable amount of hoist-control work; assembling and wiring components to satisfy customers' exact specifications relating to multiple operating speeds, forward-and-reverse and/or up-and-down movements.

3. Due to a comprehensive assortment of portable equipment and testing devices, **Pacific Electric Motor Co.**, Oakland, can perform numerous service functions on customers' premises, thereby eliminating trucking, minimizing downtime and generally shortening service cycles. For example, a portable oil dryer and filter unit can be taken into the field or an industrial plant; samples of transformer oil can be checked for dielectric strength and, if readings are low, oil can be cleaned and filtered immediately.

4. Winding small coils is facilitated in the shop of the **San Jose Armature and Motor Works** through use of practical funnel-tops that fit standard metal magnet-wire containers. These devices were made by cutting circular



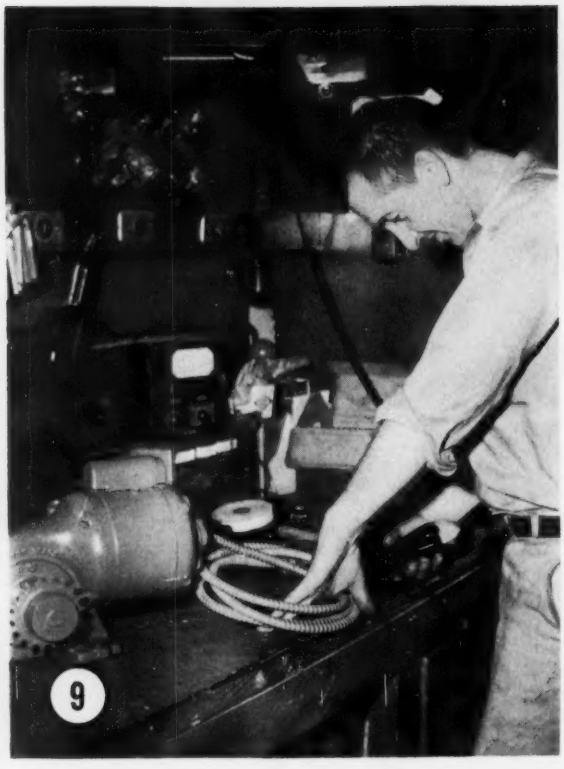


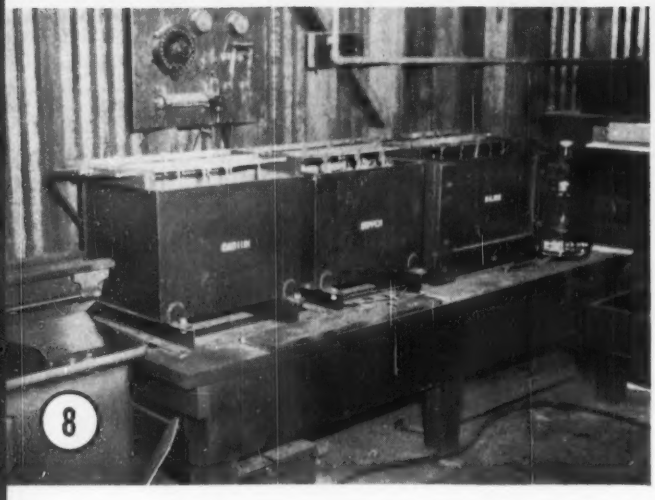
holes in container tops to coincide with upper perimeters of medium-sized funnels; funnels then being placed upside-down atop cans and braised over the holes. Since tops and containers are standard sized, tops can be used over and over by merely removing plain covers of new wire containers and replacing them with these funnel devices as shown, using common oversized paper clips as lip fasteners.

Since wire unreels easily from can-contained cardboard cores, it is unnecessary to employ supplemental de-reeling rigs. Therefore wire is merely pulled from the funnels, through related labyrinths of holes bored in guide boards, thence to coil winders. In this manner, wire is kept from tangling; many strands of similarly sized wire are available for simultaneous pairing at winding stands, and routines are simplified.

5. In the shop of **Kuchel and Sievers Electric Works,** San Francisco, micro-switch sump-pump controls are tested by a rig simulating actual water pressures which would be experienced in actual practice. In this operation, compressed-air hoses are connected into pump diaphragm chambers and air pressure is then adjusted to coincide with desired cut-in and cut-out depths of water. This useful testing device can be adjusted to reproduce desired currents between the ranges of zero and 50 volts dc, or between zero and 250 volts ac.

6. Elevating, rotating work stands in the shop of **Roy M. Butcher,** San Jose, consist of base sections formed from large-diameter pipe sections and pyramid bracing angles, and top sections formed from circular steel deck plates welded atop smaller-sized pipe sections that slide into the lower counterparts. The unique feature of the assemblies, however, concerns the addition of small hydraulic jacks with vertical rods capped by rollers. By inserting detachable levers into jacking sleeves, vertical height of work tables can be quickly regulated to suit the convenience of various workers, while presence of the roller makes it possible for workers to rotate table tops at will. As noted, structural members are formed from heavy-gauge plate, angles and pipe sections, and all components intended to remain firmly connected are welded to each other.





7. Thoroughly clean motor frames are obtained, prior to rewinding and reassembly, due to sandblasting treatment included in the repair cycle of the **California Electric Co.**, Oakland. This operation is performed in a free-standing booth equipped with full-width full-height hinged door on one side to provide maximum access to the booth rack where frames to be cleaned are placed. Then, after the hinged door has been closed, an operator thrusts his hands through rubber-sleeved armholes located in the front panel of the booth, and is thereby able to manipulate the flexible hose and nozzle through which fine sand is directed against components to be cleaned.

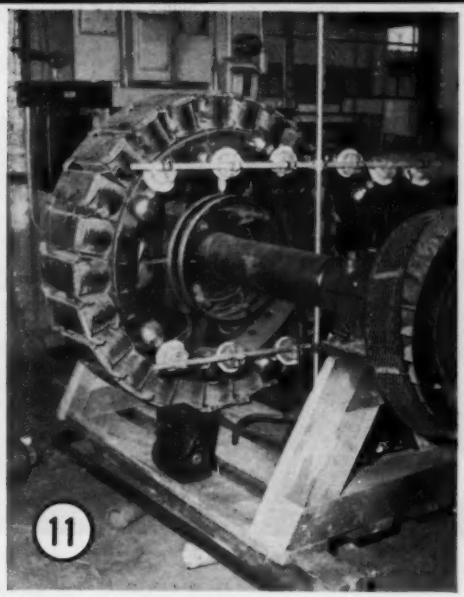
With a large glass viewing port located above arm holes, and with lighting fixtures located inside the booth above the work area, the operator has a clear, unobstructed view of the interior. And, since the sandblast is regulated by pressure on a foot pedal and then gravity-returned to a truncated reclamation chamber located beneath the booth's grated work-supporting floor, the cleaning medium can be exactly controlled and completely salvaged for reuse.

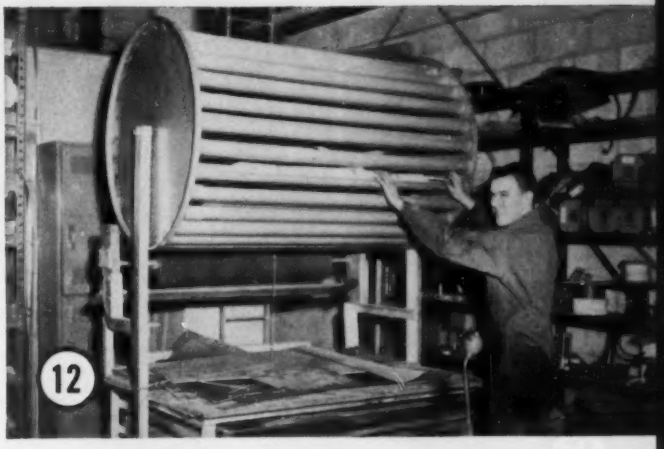
Since the operator's hands are protected by rubber gauntlets, since the door is gasketed, and since an overhead exhaust vent removes dust from the booth, this operation is exceptionally clean—for operator, shop environment in general, and for components being reconditioned as well.

8. **Lindstrom, Inc.**, San Francisco, finds frequent use for a series of plating tanks formed from sheet metal, seam-welded, then coated with metal-protecting asphaltum. Speed and amount of metallic transfer from electrolyte to immersed parts is controlled by rheostat-regulated dc current flow, while a variety of plating demands involve such varied applications as silver, copper, cadmium, zinc and the like.

9. Considerable use of automatically retracting cable reels (see arrow in accompanying photo) is evident in the shop of **Rosendin Electric**, San Jose, where test leads and extension cords are kept neatly coiled. Not only is shop appearance improved in this manner, but cables are out of sight and out of harm when not in use; tangling is absent, and cable coverings are neither grease-smeared nor damaged by being left on workbench tops or shop floor where they might be inadvertently burned by a soldering iron, abraded by wire brush or emery disc, pinched or bruised by tools or rolling equipment.

It will also be noted in the photo that benches in this shop are pro-





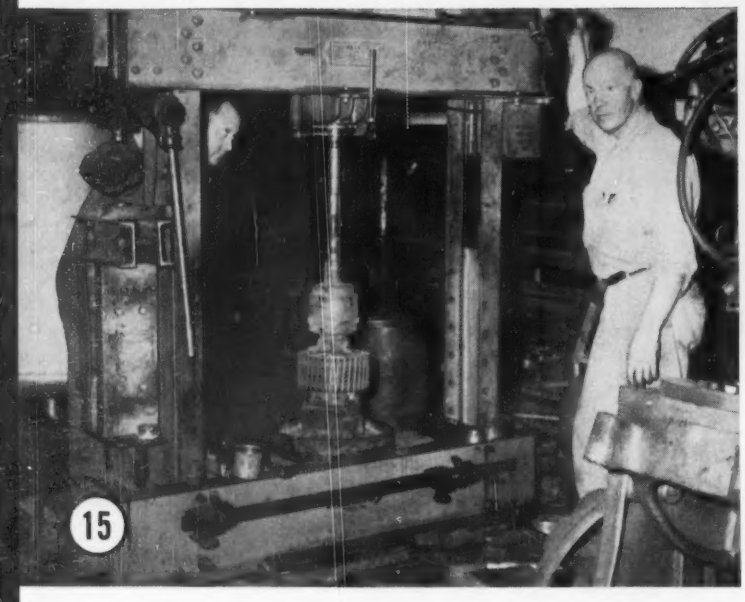
vided with tong ammeters, electric soldering guns, portable voltmeters, rotating bottle racks to hold small parts, convenient receptacles related to several commonly required voltages, and that lighting is kept high-level and shadowless by overhead continuous runs of suspended fluorescent luminaires.

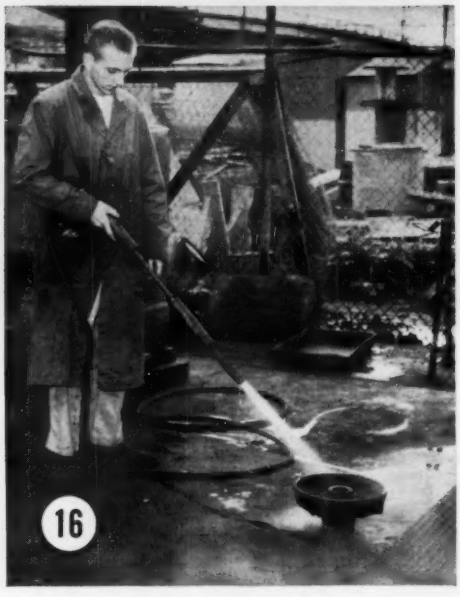
10. Employees of **Enterprise Electric Works,** San Francisco, repairing fractional-hp motors, are provided with "everything within reach" to facilitate their work. For example, numerous reels of vari-sized and insulated wire are cradled by pairs of parallel spindles located above rear lips of work benches; soldering irons are kept hot on hooded bench-mounted burners; trouble-shooting and testing meters and devices are within reach on bench sections reserved for storage of such equipment, while slot paper, wedges, sleeves and other small parts are contained in readily accessible bins and bench drawers.

11. When windings are being baked on machines too large to be easily moved or contained in a standard baking oven, **Weidenthal Gosliner,** San Francisco, utilizes a portable infrared lamp assembly consisting of a channel-section base; pipe-formed feet, upright stem and adjustable crossarms; series of porcelain sockets mounted to standard outlet boxes, and sections of flexible neoprene-jacketed connection and extension cable. Height of crossarms and spacing of lamps may be adjusted by easily tightened butterfly or wing nuts, while heat is concentrated within the desired area by means of a fireproof canvas boot that may be placed tent-fashion around the lamps, supporting rig and coil complex.

12. Numerous practical methods may be observed during a visit to the shop of **Benkiser Electric Motors,** Oakland; one of the many being a novel ferris-wheel storage rack for insulation, sleeving, slot wedges, spaghetti and the like. Consisting of 30 semi-circular trough sections mounted between 3-ft-dia endplates, the assembly may be rotated to bring desired items of material within easy reach of workers. This also saves considerable time.

Since troughs are supported at each end by pivot pins, located above centers of gravity, the troughs hang level at all times. And, since troughs measure 5 ft in over-all length, they are suitable for holding standard lengths of materials noted above. The device, designed by Benkiser and fabricated in a local shop, is internally braced by a stiffening framework of small-cross-section channel members.





13. Cleaning various parts of small motors is facilitated in the shop of **Conrad Electric,** Oakland, by use of a self-contained compact pressure-spray tank which is equipped with a reservoir of degreasing and cleaning fluid; hose and pump to provide the liquid with direction and pressure; drainage grid to support brushes and related accessories; an agitating unit placed at the bottom of the solvent tank that sloshes cleaning fluid through motors and parts, also a strainer and filter that catches and retains grit and metal particles so they will not be recirculated during cycles of subsequent reuse. A hinged metal cover is spring-loaded to facilitate easy opening when desired, and this cover may be closed either manually when the tank is not in operation or, in the unlikely event of a flash fire, it would close automatically due to the existence of a melting link in a catch designed to separate should temperatures reach 165 degrees.

14. It is a rare occasion when a visitor to the shop of the **Buzzell Electric Works,** San Francisco, will not find jobs-in-progress involving special motors, such as the synchronous generator pictured in an accompanying illustration. In this instance a special stator was being wound for a 1200-rpm 625-kva unit, after which coil leads were grouped, banded with copper sleeves, soldered, wrapped with glass tape, varnished and baked.

15. Another shop located in San Francisco is the **Reyna Electric Works,** an organization equipped with heavy-duty equipment such as the 60-ton hydraulic press shown above. With adjustable bearing frame, hefty thrust shaft, convenient oil reservoir, pump, dials and controls, this item of equipment expedites a wide range of repairs.

16. Steam cleaning of motor frames, rotors and end bells prior to reconditioning of motors is standard procedure at **Ed Kurze's Shop,** San Jose, where an outdoor boiler and jet nozzle provides high-pressure steam at sufficient temperature to quickly degrease all components awaiting rewinding or reassembly.

• *ESTIMATING FORUM—XI*

Estimating Productivity of Mechanics

Part I—Attitude of Mechanics

By **Ray Ashley,** *Research and Consulting Engineer, Oak Park, Ill.*

STATEMENT: **When there is a skilled manpower shortage, some of the less desirable mechanics must be tolerated. When we say "tolerated," we are thinking of mechanics with the wrong attitude.**

There are many characteristics and qualifications that make one mechanic less, or more, desirable than another. Studies show that "attitude" is an outstanding characteristic.

QUESTION: **What percentage of the working day can be wasted by the indifferent mechanic?**

ANSWER: **Wasted time can range from 25% to 40% of the working day.**

DISCUSSION:

The effect on productivity due to a mechanic's attitude has never entirely escaped the attention of electrical contractors. Its full significance, however, is not realized until we begin to spell it out with figures. This is what we plan in this discussion.

The accompanying table provides a comparison which highlights the ill effects of poor attitude. Values listed are for ordinary industrial work. Column "A" represents the record of an indifferent mechanic. Column "B" presents the author's proposed standard of acceptable allowances. To thoroughly understand the comparison, let us investigate both listings in detail.

(Continued on page 134)

ATTITUDE OF MECHANICS

Effect On Productivity

Operation	Time in Minutes A*	B**
Changing clothes—in morning	10	—
Selecting tools and getting on the job	15	10
Coffee break—9:30 AM	15	10
Preparation for lunch	15	10
Return to work after lunch	15	5
Coffee break—2:30 PM	15	10
Relief periods	30	20
Pick up and prepare to leave—afternoon	20	15
Sitting around waiting for 4:30 (quitting time)	10	—
Carelessness (spoiled work, false moves, etc.)	15	—
	160	80
Lack of dispatch 10% of 320 (480—160)	32	—
Totals	**192**	**80**

Excess time for "A" (192—80)—112 minutes

* Column A represents record of an indifferent mechanic.

** Column B lists proposed standards.

MOTORING GUESTS, driving into garage lobby, are advised by luminous signs to park and step inside acoustically paneled television registration booth. As guests enter booth, pressure switch beneath rubber floor mat activates TV, sound and lighting systems. Thereupon, an . . .

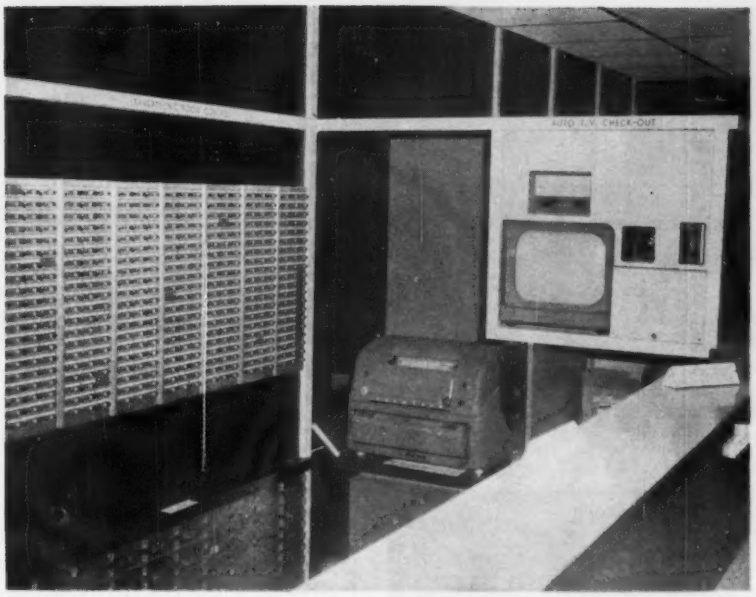
AUDIO-VISUAL link is established between guest in garage and clerk at lobby desk, who verifies reservations, delivers room key via pneumatic tube and directs guest's attention to garage ramps, room locations and various public areas by remotely activating colored lights located beneath glass-top registration desk.

Electrical System Features of Jack Tar Hotel

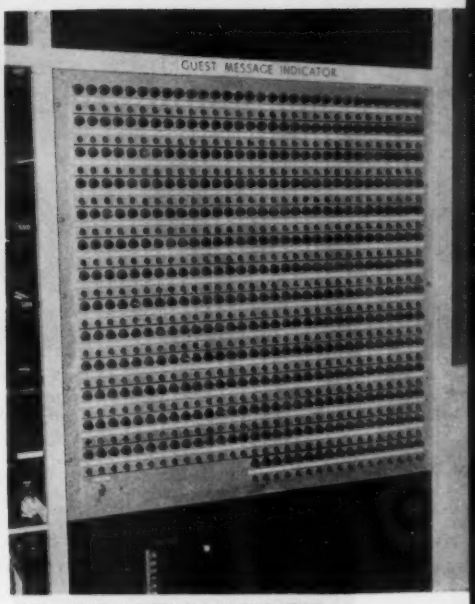
New San Francisco hotel-office building electrical facilities include TV communication and other special systems to speed service. Two 3000-amp services power the installation, a joint venture by Emil J. Weber and Brayer Electric Companies.

By Lloyd G. Dehrer
Chief Electrical Engineer
Buonaccorsi & Murray, Consulting Engineers, San Francisco, Calif.

SAN FRANCISCO's new Jack Tar Hotel is a modern $12-million structure containing a wealth of practical ideas related to power distribution and control, electric heating and air conditioning, lighting and communication. It is also an installation of extremes and size: voltage values range from a 12,000-volt utility network service to a 12-volt special lighting installation; approximately 350 miles of wire are contained in 85 miles of conduit in diameters up to 5 in.; nearly 15,000 lamp bulbs are installed in 7,500 fixtures and ceiling outlets. The building includes 25 power transformers, 122 distribution panels and over 3000 lighting control switches; and over



ROOM STATUS BOARD, located adjacent to cashier's checkout TV monitor, shows (via colored lamps) whether rooms are occupied (amber), just vacated and awaiting terminal cleaning (red), or awaiting reassignment (green). Duplicate boards also advise hotel manager, room clerk and housekeeper of room status.



LUMINOUS MESSAGE INDICATOR, located behind lobby registration desk, advises guests (by lighted green lamps) when letters, telegrams or packages are being held for them. When clerk flips key to light any room-related lamp, a duplicate luminous indicator is lighted in foyer of the corresponding guest room.

78,000 man-hours were required for the installation.

The block-square building contains over 400 guest rooms, extensive convention facilities, a 12-story office wing, a multi-level garage, numerous restaurants, a heated and illuminated swimming pool and an outdoor all-year ice-skating rink.

For hotel guests there are many electrical innovations designed to speed service:

. . . Registrations and check-outs are completed quickly and easily from motor-lobby booths incorporating closed-circuit television plus phone and pneumatic tube contacts with clerks and cashiers at the main desk.

. . . Clerks, cashiers, housekeeper and manager are notified promptly whenever a change in room status occurs by multi-color illuminated annunciators as soon as rooms are (1) assigned for occupancy, (2) evacuated and ready for final clean-up, or (3) cleaned and ready for reassignment.

. . . Guests may dial outside phone calls (local and long-distance) directly, while calls are electrically registered and promptly recorded on guests' bills so that this information is instantly available at check-out time.

. . . Guests are advised promptly, via illuminated message indicators located in guest-room foyers and above lobby-desk mail-slots, as soon as messages are received for them at the main desk.

. . . Paging by numerous close-spaced speakers in all public areas insure wide-area dissemination of low-volume announcements.

. . . Intercommunication between various service stations, operating and management offices is speeded through use of a variety of telautograph, signaling, phone and speaker systems.

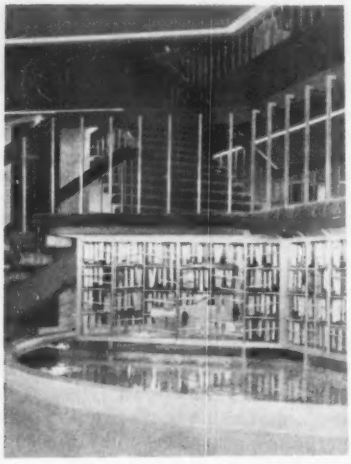
TV Registration

Motoring guests become aware of these time-saving services as soon as they drive into the street-level garage lobby, for they are immediately advised (by illuminated signs) where to stop their cars, where to find the conveniently located acoustically paneled TV registration booth, and where to stand on the booth's pressure-sensitive rubber mat in order to automatically establish television and intercom connections with the main desk. As twin television cameras and picture tubes are located at both ends of the circuit (main desk and registration booth), guests and clerks are placed in mutual visual contact.

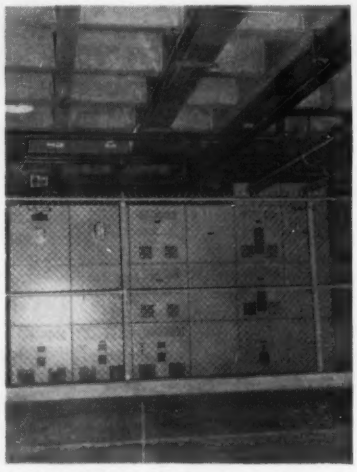
When room assignments have been completed, clerks use a pneumatic tube to provide guests with their room keys. Clerks may also refer to illuminated floor plans in front of the guests to call attention to garage ramps, parking areas, doorways and corridors related to specific room assignments. When guests return to their cars, they are further assisted in reaching their upper-floor destinations by color-coded stripes painted on the various ramps, and by additional illuminated signs identifying turns, floor levels, parking spaces and doorways leading to hotel or office lobbies, elevators, corridors or stairways. Lighted signs also advise motorists to "remember the location where your car is parked"; to "drive slowly" and "give way to merging traffic."

When guests check out, this general procedure is reversed, for guests then drive down to a street-level check-out booth where they are again placed in TV contact with the

MODERN LOBBY features 4-way cantilever stairway leading to mezzanine devoted almost entirely to convention facilities. Threshold from upper car entrance may be seen at left, portion of registration and check-out desk at rear right. Note luminous fluorescent soffits defining irregular outline of stairwell.



UNIQUE POOL and metal latticework beneath intermediate stair landing in center of main lobby. Lattice, combining paste jewels with leaves of various metals, is top-lighted by recessed fluorescent troughs, up-lighted by pool-submerged incandescent floodlights in several colors, and given life and sparkle by trickling water curtain.



ELECTRICAL SERVICE is through two 460Y/265-volt switchboards, interconnected by ventilated low-impedance bus-ducts suspended from garage floorslabs. Duct assemblies are braced to withstand high short-circuit stresses, are designed with multiple phase bars interleaved so as to provide repeating phase sequences and can provide two independent circuits.

cashier department. In this case the pneumatic tube is used to transmit bills, checks, receipts or change between the two stations.

Car entrance and exit lanes at street level are brightly illuminated by four overhead continuous rows of plastic-shielded 2-lamp fluorescent luminaires, while car-servicing facilities (such as gasoline pumps, wash and lube racks) are also conveniently available. Such areas are equipped with explosion-proof luminaires, switches and circuiting components, exhaust fans and ducts, while attendant stations are additionally equipped with electric heating units, clocks, time stamps, garage-intercom panels, cash registers and duplex receptacles for other electrical equipment, as required.

As motorists finally reach the exit ramp, their cars pass over a pad containing pneumatic tubing that activates detection relays and contacts which, in turn, trigger a double-faced flashing illuminated sign and bell located above adjacent exterior sidewalk areas to warn pedestrians of the approaching cars.

As soon as a check-out has been completed, the cashier presses a room-related button on the main-desk room status board. This action lights red bull's-eye on this board plus duplicate boards located in the offices of the manager and housekeeper. Upon noticing the red light, the housekeeper promptly advises the floor maid involved. This intercommunication is effected by telautograph, an installation that records written messages for the subsequent information of addresses if receiving stations are unoccupied at time of initial message transmission.

As soon as the room has been cleaned and is ready for reassignment, the housekeeper presses another room-related button that changes the red lights on the various room status boards to green. And, upon reassignment, the room clerk presses still another related button that changes the green light to amber.

All rooms are air conditioned and are equipped with message indicators and both radio and television facilities.

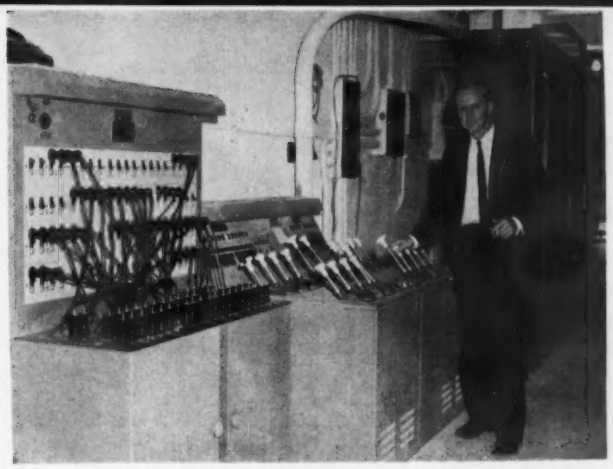
Convention Facilities

Large meeting rooms may be subdivided by motorized sliding partitions to form tailored-size accommodations for smaller meetings, banquets, schools and theatre use when desired, and all accommodations are provided with facilities for radio, TV, public address and background music. In addition, the main ballroom has complete theatre accessories including house-and-stage lighting, a curved Cinemascope screen, plus an elevated rear-auditorium projection, lighting and sound control booth equipped with modern dimming console, circuit patch panel and transcription equipment.

Throughout the building, air conditioning (backed by two 450-hp compressors) and temperature regulation of all rooms are monitored and controlled from a selectograph station in the engineer's office. This station contains back-lighted mimic system panels revealing equipment in operation and the status of all damper settings, high pressure fans, boilers, pumps, refrigeration and hot-water system components.

Basic Power Distribution

The structure is served through two 460Y/265-volt switchboards: One assembly located in the hotel wing having the dual assignment of primary switching and office distribution, the second board serving all



COMPLETE THEATRE FACILITIES for main ballroom include flexible house- and stage-lighting control console and patch panel, curved Cinemascope screen and projection equipment, motorized sliding partitions to subdivide the larger hall, also accommodations for radio, public address, background transcribed music, and initiation or reception of closed-circuit or commercial-channel television.

SELECTOGRAPH STATION in engineer's office permits supervisor to monitor and regulate air conditioning in all major rooms and public areas throughout the building. Backlighted mimic system-panels visually indicate status of refrigeration compressors, standby pumps, cooling towers and valve pressures, hot water pumps with steam, supply and return water temperatures. The two compressors total 900 hp.

demands related to the hotel, garage and combined services such as air conditioning.

Connections between the 12-kv/465-volt utility vault, the two main distribution boards, and numerous upper-floor secondary transformer stations are effected through ventilated low-impedance busducts. Ducts rated above 1000 amps are braced to withstand short-circuit stresses up to 75,000 rms amps; and ducts having lower ratings are designed for stresses a third less in magnitude.

The larger-capacity busducts are also designed with multiple phase bars interleaved to provide repeating phase sequences, and load take-off devices for such runs consist of bolted-on thermal-magnetic breakers containing built-in current-limiting fuses having interrupting capacities in the order of 100,000 amps.

Busducts rated below 1000 amps are plug-in assemblies with bars and collection straps arranged so that, if desired, straps may be removed in order to obtain two completely independent circuits within the same housing. On these busduct runs, plug-in openings are provided with safety slides interlocked with the housing so that access to bars is possible only when plug-in units have been positively attached. Interlocks also prevent removal of plugs or opening of doors when switches are ON, although, when switches are OFF, the protective slides may be closed over them without disturbing actual plug connections.

All horizontal busduct runs are supported at least every 5 ft, vertical runs being supported at every floor slab or, when floor-to-floor distances exceed 12 ft, by intermediate spring-adjusted supporting hangers as well. Flanges and firestops are installed around bus housings at all points where they pass through walls, partitions or floor-slabs.

The two main utility-service circuit breakers are 3000-amp air assemblies with dual magnetic trips, while all switchboard feeder breakers are provided with current-limiting fuses on their load sides to protect lower-rated molded-case breakers installed in the various local distribution panels located throughout the building. All breakers are coordinated.

Motor control centers and distribution centers, controlling fluorescent lighting in the office wing, are 460Y/265-volt assemblies, while MCCs also have horizontal and vertical buses braced to withstand severe short-circuit stresses. These control centers likewise have ample wireways located horizontally at both top and bottom of grouped cubicles, while additional wiring channels are provided vertically between the contained motor starters and side panels of the tierred enclosures.

Secondary control centers for 120/208-volt lighting and receptacle circuits obtain 3-phase 4-wire power from dry-type transformers having built-in vibration dampers and (for units rated up to 300 kva) sound levels below 50 decibels.

Separate emergency lighting systems, operating from storage batteries and activated by automatic transfer switches upon interruption of normal power, are provided.

Circuit Color Coding

Due to the extent and diversification of wiring systems in the building (power, alarms, telephone, intercom, TV and the like), a major construction problem was to keep the various systems separated and identified to preclude any possibility of erroneous routing or panel connections. This was accomplished by color coding conduits and conductors, as, for example, spraying power conduits blue, fire alarm conduits red, lighting conduits yellow, and so on. Also distinctive color schemes for 480- and 120-volt power, etc. were maintained.

All wiring is in rigid steel conduit whenever circuits are contained in slabs or concrete walls. Where conduits cross expansion joints, pull fittings are installed on each side of the joint, with connection loops of flexible conduit between.

The structure was designed by architects Thomas M. Price of Galveston, Texas. Hertzka & Knowles, San Francisco, were the architects in charge of construction.

Electrical and mechanical engineering was by Buonaccorsi & Murray and J. A. Poole.

The electrical installation was a joint venture by Emil J. Weber and Brayer Electric Companies; with James L. Dellos serving as supervisor, Frank Voightlander as superintendent, and Walter Banchi as assistant.

Electrical contractor designs and installs . . .

Packaged Wiring for

John Denardo, electrical contractor of Maplewood, N. J., is the electrifying force behind production of completely pre-fabricated diners at the plant of Fodero Dining Car Company, Bloomfield, N. J.

By J. F. McPartland

FROM Canada to the Gulf, from the Atlantic to the Mississippi, there are many diners boasting expert electrical installations by John Denardo, electrical contractor, Maplewood, N. J. And John has done all this work without leaving New Jersey. In fact, he has done all of this work in a plant in Bloomfield, N. J., where all sizes and styles of modern diners are completely pre-fabricated.

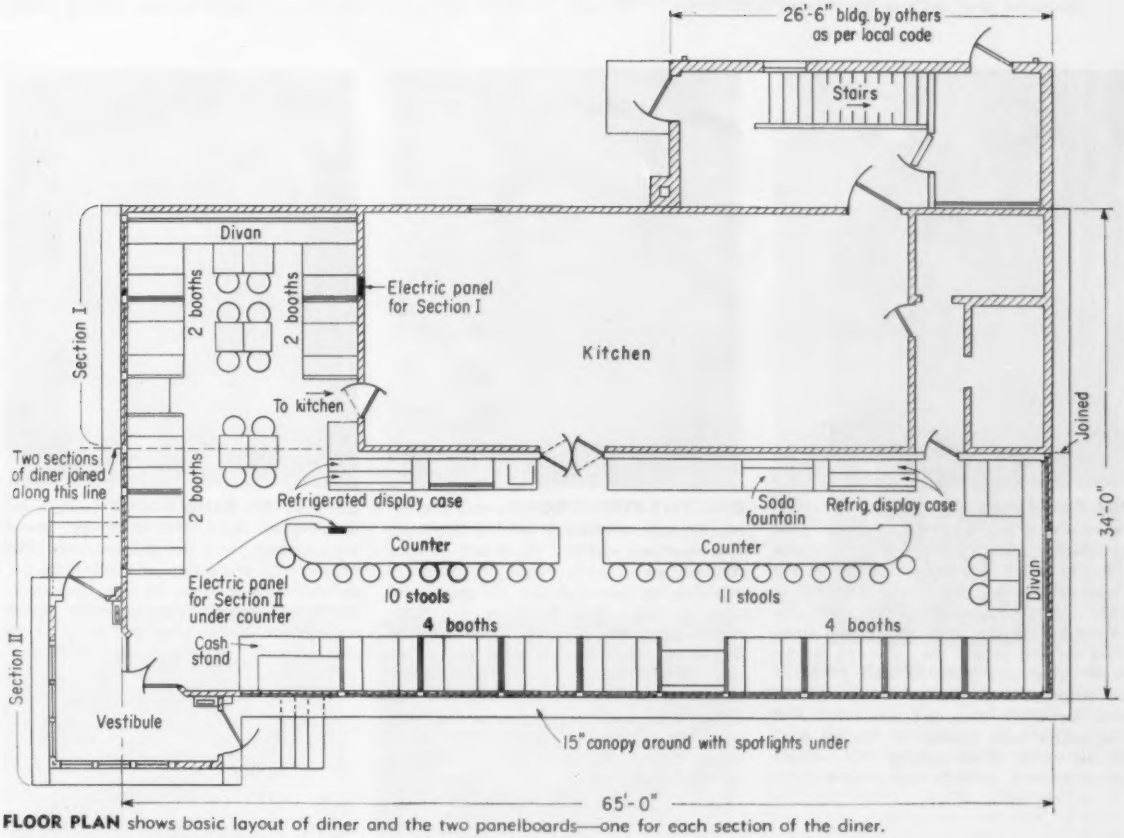
Fodero Dining Car Company builds diners at their plant. This includes all of the structural work and interior and exterior finishes—plaster work, terrazzo floors, stainless steel, marble, tile and exterior stone finishes. These diners are also completely equipped with cooking equipment and all of the other devices used in a diner. When completed each diner is ready to be transported on a trailer to the site of its installation. The diners are generally made in two sections to facilitate transportation; the sections can be readily joined together at time of installation. At the site, installation simply consists of setting the diner on its foundations and making the necessary service connections—water, gas, electricity. The diner is then ready for business.

FINISHED INTERIOR of typical diner is attractively decorated and well lighted by decorative incandescent units along outside wall (extreme right, over tables), by five-light cluster fixtures over the aisle (center) and by floodlamps in swivel-type bullet housings for work area (at left). Additional wiring provides plenty of receptacle outlets and flex circuits for power and speaker lines for juke-box system.

John Denardo contracts for the complete wiring in each trailer. Basically, the lighting and appliance outlets in each of the two sections of a diner are circuited from a separate panelboard in each section. The size of these panelboards and the number of circuits required will depend upon the size of the diner and the electrical loads. Some diners, for instance, are wired for complete electrical operation — lighting, heating and cooking. Such units, of course, are much more heavily circuited.

Complete wiring for a diner consists of all circuits from the panels and all finished outlets, including installation of lighting fixtures. At the site of installation for a diner, the electrical contractor who will complete the installation has to bring in the electrical service, install the service-entrance equipment and provide a feeder to the branch circuit panelboard in each section of the diner. The over-all electrical

Diners



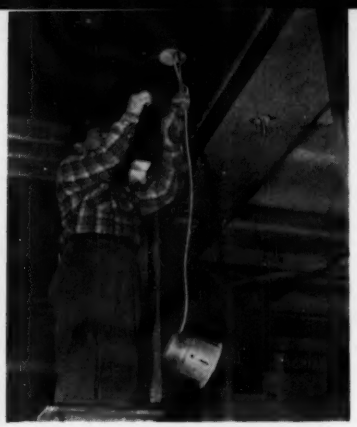
FLOOR PLAN shows basic layout of diner and the two panelboards—one for each section of the diner.

system is then ready for final inspection.

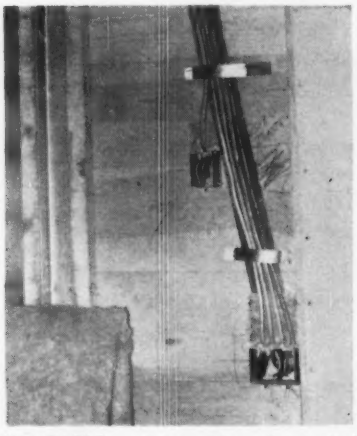
The type of wiring system used in any diner will depend upon code rules in effect at the location where the diner is to be installed. In most cases, armored cable is the method used. In some cases, thin-wall or rigid conduit may be required. And in other cases, non-metallic sheathed cable may be called for. In all cases, installation is made according to the National Electrical Code and any special code provisions at the site of installation.

One of the most interesting factors in wiring of each of the diners is the extremely high order of workmanship demonstrated by John Denardo. In his work, a careful, conscientious approach combines with unusual mechanical skill and years of experience to produce neat and effective wiring with high operating reliability and safety. Reference to the many details shown in accompanying photos re-

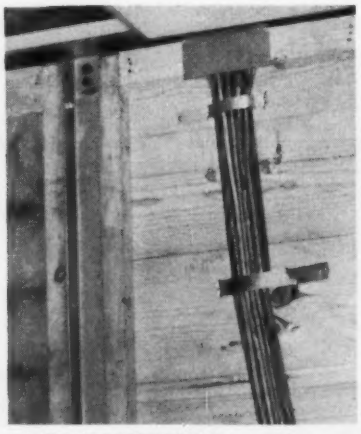
UNDER CONSTRUCTION, a typical diner is shown here in the Fodero plant in Bloomfield, N. J. The diner is built in two sections, with the sections joined during construction as they will be when finally installed. When construction of the diner is completed at the factory, the two sections are separated and each is transported separately to the site of installation.



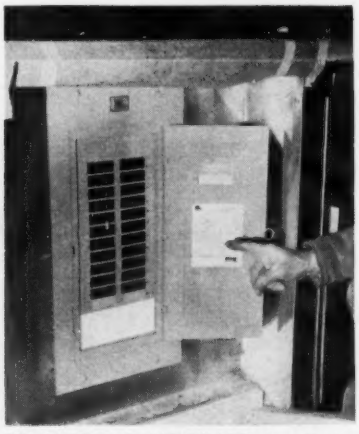
CANOPY LIGHTS around perimeter of roof overhang are 150-watt, R-40 lamps in recessed hi-hat housings. Each unit is supplied by No. 14 type AF fixture wire in 4-ft length of 3/8-in. flex run from the 4-in. octagon box shown. The box is supplied from the 2-conductor No. 12 non-metallic sheathed cable used for 20-amp branch circuits. Here John Denardo makes the splices in the box which will be left as a "floating box" in the space.



NM CABLE used for wiring of a typical diner was required by the electrical code in effect in the city where this particular diner is to be installed. Typical of the thoroughness and rigid craftsmanship of John Denardo, the cable runs are protected by No. 12 gage galvanized sheet steel secured behind the cables to protect them from any possible nail or screw penetrations from the other side of the wall on which they are mounted. And the cables here happen to be mounted on the inside of an outside wall—where penetration is already highly unlikely.



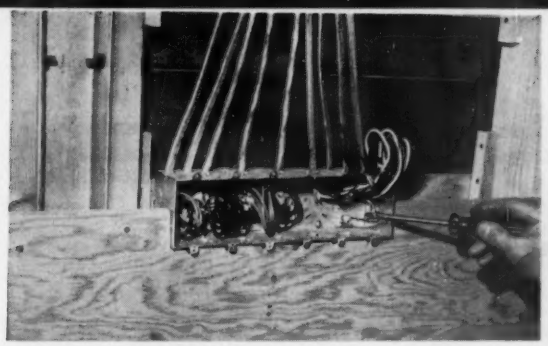
EFFECTIVE PROTECTION for cables passing through notched or drilled construction members within 2 in. of any surface through which nails might be driven is provided by pieces of No. 12 gage steel plate as shown here. Basically, this technique conforms to NE Code section 300-8 (b), with almost twice the thickness of steel required by the code. Note that structural steel I beams and U-uprights form the building frame and support, eliminating any concern over weakening of the structure due to notching of wood members.



COMPLETED PANELBOARD installation in a typical diner (this is the one under the counter) bears the rough-wiring label of electrical inspection of the Middle Department Association of Fire Underwriters. Final inspection will be made by the appropriate authority at the place of installation.

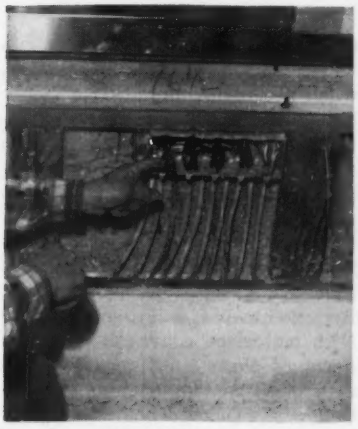
veals the quality of his work. In particular, they show the neat training of wires in gutters, careful attention to continuity and capacity in the equipment ground circuit and effective protection of conductors against physical damage.

Inspection of electrical wiring in each diner made by Fodero is made at the factory on a preliminary or rough wiring basis. All concealed wiring in these diners is inspected by the Middle Department Association of Fire Underwriters. A rough wiring approval certificate is issued in duplicate for each diner which meets the requirements of the National Electrical Code. This rough wiring approval is issued to the permanent serial number which the manufacturer assigns to each diner. (This serial number is assigned in the same way a serial number is given to every automobile.) One copy of the rough approval goes into the manufacturer's records and the other copy goes with the diner to its place of installation. Final electrical inspection of any diner is made by the inspection authority at the place of installation of the diner. This might be in Florida, Michigan, Georgia, Maine—or just about any state East of the Mississippi.

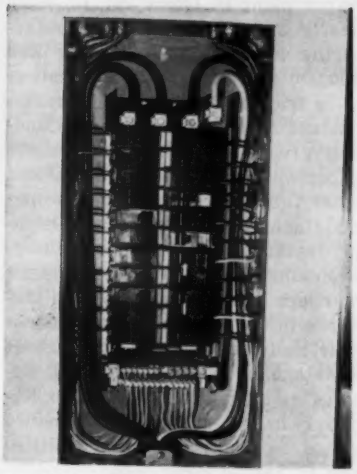


EFFECTIVE GROUNDING of boxes, fixtures and connected appliances is provided throughout the NM system by means of a bare grounding conductor run in each cable assembly —both 2-wire and 3-wire cable, as used here for line and load feeds for a bank of boxes for five switches and one plug receptacle. The ground wires are twisted together in groups and crimp-connected to a small U-lug as shown here. The lug is then secured firmly to the box assembly by means of the machine screw shown. Where possible, one of the cable clamps included in the box was removed and the screw that normally holds the clamp was used to ground the bare wires to the box. Where such a machine screw was not available in the box—either because both clamps were used or there were no clamps—John Denardo drilled a hole in the box wall, tapped it and inserted a machine screw to make the ground.

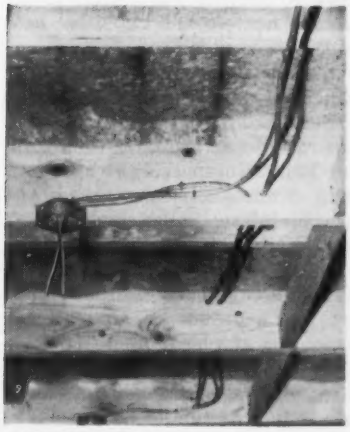
TWO SWITCHES installed in end of counter are shown roughed-in (left) and finished (right).



TYPICAL OUTLETS in outside wall at the cashier's location are installed on wood framing just above floor level (left), and the same outlets are shown finished in another diner (right).



TYPICAL PANEL in diner is a neatly wired 100-amp load center (this particular unit wired with No. 12 armored cable). Note careful separation of feeder conductors from branch-circuit conductors in panel gutter to minimize possibility of feeder-to-branch faults. The wiring in this panel exemplifies the type of work John Denardo does in each diner wiring job. Even such a little detail as insertion of branch neutral conductors in lugs gets a careful touch from John. He skins the wire about 1½ in., then bends the bare section in half, back on itself, in order to provide a more substantial amount of conductor to insert in the terminal for the pressure screw to bear on. John has found that a single cross section of No. 12 conductor may not be properly compressed into a firm connection because of its small size in relation to the pressure surface.



CEILING DETAILS of wiring include: (left) an outlet box for one of the decorative fixtures which will be mounted over the aisle between the counter and the booths (note that deep joist is notched to provide flush mounting of box); and (right) feeding cable through holes in joist and stapling to 2 by 4 crosspiece between deep joists.

Effective Large-Plant Maintenance

Central maintenance operations plus an area maintenance plan keep downtime to a minimum—efficiency to a maximum at GE's Radio Receiver plant in Utica, N. Y. Here, preventive electrical maintenance and standardization of equipment are combined in a highly practical, smoothly operating maintenance program.

By Robert J. Lawrie

AREA maintenance and standardization of equipment greatly simplify electrical maintenance at General Electric Co.'s Radio Receiver plant in Utica, N. Y. With nearly 200,000 sq ft of manufacturing space in one building and 100,000 sq ft in another, distances to be traveled from a central maintenance area would be understandably great. In addition, centralized paper work, spare parts control and other functions required for proper maintenance of this large high-production plant would be overwhelming. But, with each unit manager responsible for maintenance in his own area, downtime is practically non-existent and efficient maintenance is easily obtained. Besides area maintenance, Radio Receiver has a central maintenance group to maintain plant utilities and to handle large jobs.

Standardization of electrical equipment, particularly in production areas, significantly reduces downtime. Hundreds of motors, controls, and electrical parts used on various machines and assembly lines are of the same design. This facilitates rapid replacement in case of electrical failure and allows a minimum spare parts inventory. In addition, because maintenance men have less varied types of equipment to service, they become familiar with the selected standard type of equipment and maintain it more efficiently.

A personal interview with Jim Wiese, manager of Manufacturing Engineering at Radio Receiver, is presented here, giving details of his electrical maintenance program plus some of his problems and how he solved them.

What is most significant about electrical maintenance at Radio Receiver?

Most significant, I would say, is that we have very little unscheduled downtime. We can't afford downtime. We manufacture the entire stock of GE's radios, consisting of table models, clock-radio models, transistor types, portable intercoms, and the soon to be released educational projects. Finished models come off the lines at an extremely high rate—a downtime of 10 to 15 minutes puts us way behind.

How do you keep downtime to a minimum?

Area maintenance and standardization of equipment are the major factors. We originally had central maintenance, but when trouble occurred, we'd lose too much time getting to it. Now we have a maintenance man in nearly every important manufacturing area. And, because he associates with the same equipment every day, he can usually make repairs quite rapidly.

> First of a series of case studies of current, industrial electrical maintenance practice. The series will cover operating procedures and actual work methods through direct personal interviews with key plant personnel.

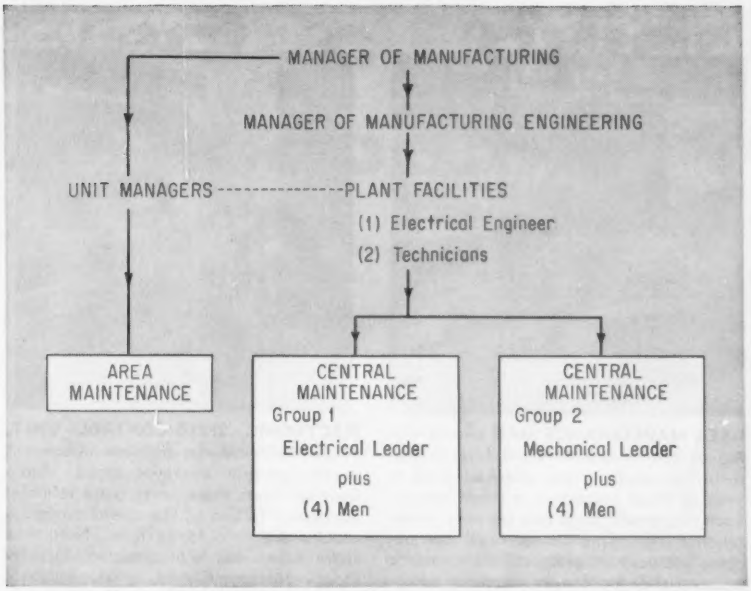
By standardizing our motors, controls, etc., maintenance men can be shifted to other departments, when necessary, and still be familiar with the equipment. In addition, standardization helps to keep our spare parts inventory down.

What type of equipment must you maintain?

Mostly motors and controls. We have a great number of machines that wind coils or form parts. And we have several assembly lines with motorized conveyors. Certain parts of these lines require accurate speed control, such as the section where printed boards are sent through a dip soldering process. In our plastic-forming area, we have several large plastic-forming machines that form the radio shells. This equipment has high-wattage electric heaters and extensive heat and speed control.

How is your electrical maintenance department organized?

Electrical maintenance is not a separate department. It comes under Plant Engineering, which consists of one electrical engineer and two high-level technicians. These men are the core of plant maintenance. They perform all plant planning and engineering. Under them are two maintenance groups, each consisting of a leader and four men. These two groups maintain the plant utilities and handle any large jobs. In addition, there are the area maintenance people who service and troubleshoot equipment in their respective areas. All maintenance men are carefully selected.



ELECTRICAL MAINTENANCE is a part of the general maintenance program. The plant engineering group forms the core of the maintenance program. An electrical engineer and his assistant direct electrical maintenance. Two central maintenance groups perform building and utility maintenance. One group, heavier with electrical men, concentrates on electrical maintenance. In manufacturing areas, each department performs its own maintenance as recommended by Plant Engineering.

They must be alert individuals able to handle electrical maintenance, mechanical maintenance, or any other miscellaneous maintenance jobs that might occur.

Do you have any electricians in these groups?

The area maintenance people are not licensed electricians. But, after receiving training from our plant engineering group and after working with the equipment day after day, they become quite efficient in electrical maintenance.

We have one electrician heading one of the central maintenance groups. Under his leadership, his group handles a heavy share of our electrical maintenance.

Do they handle any large electrical installations?

No. I've found it cheaper and faster to have contractors install larger electrical jobs.

What kind of power distribution and equipment do you have?

The utility company supplies 13.8 kv on an overhead line. An overhead metered bus runs the length of the building. From this high voltage bus run, feeders extend to five strategically located unit substations. Each substation has either a fused air switch or oil switch. Transformers step down the primary voltage to 480Y/277 volts. Protected by air circuit breakers, secondary feeder circuits carry 480Y/277 volts to various parts of the plant. And dry-type distribution transformers supply 208Y/120 volts for lighting and miscellaneous loads.

Do your maintenance people service the high-voltage apparatus?

No. I have a service contract with an outside contractor who maintains all high-voltage equipment. Besides performing regular maintenance, the contractor maintains a stock of spare parts for this equipment and he has a trouble-shooter available if the need ever arises.

Do you have an electrical preventive maintenance program?

Yes. Central maintenance carries out an EPM program, which covers building utilities and special equipment. Area maintenance people perform EPM as directed by the unit manager. Electrical preventive maintenance for each area was planned and recommended by our plant engineering department. Since each manager is responsible for the operation and cost of maintenance in his own department, he decides which maintenance procedures will be carried out.

Generally speaking, EPM occurs as part of the daily routine. In the manufacturing areas, maintenance people inspect each motor and control daily. We call it the "look-feel-smell" test. This test doesn't take long, yet we have caught many potential trouble spots by this particular method.

Central maintenance people also perform the "look-feel-smell" test during much of their daily maintenance. But on special equipment, we have check lists that must be completed.

Exactly what PM do you perform to keep your motors running?

If, during the "look-feel-smell" inspection, a maintenance man finds dirt or grease around the motor, he'll immediately clean and blow down the motor with an air hose and check for bearing or seal failure. Once a year, running current and voltage at each large motor (10 hp or over) is checked and recorded. Insulation resistance tests are performed and recorded yearly.

If a motor winding burns out, we send it to be repaired. Replacement of worn bearings is the only motor-repair work we perform by ourselves.

How do you maintain your electronic speed-control panels?

We find them quite reliable. Failure of these panels, though infrequent, is usually due to a bad tube. We keep spare tubes handy inside or near the control panel for rapid replacement. And about every three months, area maintenance will blow out any dust or dirt.

Suppose a speed control failed and, after replacing the tubes, it still doesn't operate—what do you do?

If this happens, and the area man can't find the trouble in five minutes, he calls electronic technicians from the production test area. Between themselves, they will decide whether to replace the unit or repair it, whichever is quicker.

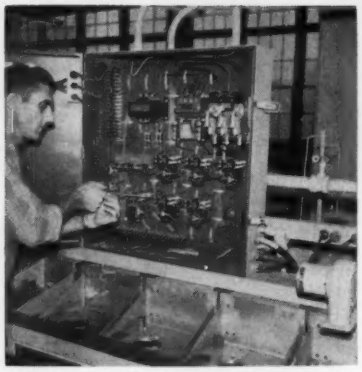
How do you maintain switches, feeders and busways?

Every month, 440-volt safety switches are blown-out with air. At the same time, a visual inspection of the switch is made. The 440-volt feeders and all busways are Meggered once a year. These insulation-resistance readings are recorded for future reference.

Do you ever check electrical connections?

On special or important equipment, we'll check connections about once a year. On equipment subject

ELECTRONIC TEST equipment, used to check table-model radio receivers, is maintained by an electronic technician assigned to this area. This sensitive equipment not only tests receivers, but, as a side effect, also detects loose connections in the building wiring. Because a loose connection often arcs, the resultant high-frequency harmonics are picked-up by the instruments. Since test technicians cannot tolerate this interference, maintenance must locate and eliminate the trouble.



AREA MAINTENANCE MAN checks wiring at control panel. On special equipment, connections are checked once a year; a visual inspection is made weekly. Each important area has its own maintenance man. Area maintenance men become efficient in electrical maintenance because they work with the same equipment daily. And area maintenance significantly reduces centralized paper work and spare-parts control because this method was adopted.

ELECTRONIC SPEED-CONTROL UNIT, mounted on column beneath disconnect switch, controls conveyor speed. Radio Receiver finds these units quite reliable; occasional failure of the speed control is usually due to a faulty tube. Note that spare tubes are kept close to unit for rapid replacement. And, as an additional time-saver, a spare fuse of the proper size, is kept inside the safety switch. This quite often saves a trip back to the stock room.

to vibration, we check connections every three to six months. We don't have much trouble with loose connections. If a loose connection does occur, we'll find out about it because the resultant arcing produces frequency harmonics which are picked up by the radios and test equipment in our test area. Because technicians can't tolerate this interference, they immediately request that the interference (usually a loose connection) be found and eliminated. A portable radio is a handy instrument for locating electrical disturbances.

What electrical spare parts do you keep?

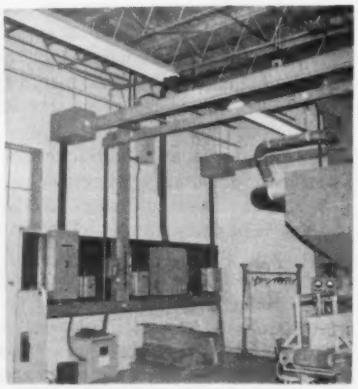
Each area maintains a spare parts inventory for its own equipment. Central maintenance inventories parts for building utilities and special equipment. Each area will inventory items such as fuses, relay contacts and motor bearings. Items such as busway switches, building wire and cable, and the like are inventoried by central maintenance. In addition, we keep one spare fuse (of the proper size) in each safety switch. This quite often saves a trip back to the stockroom.

Do you provide your men with electrical training courses?

Yes. Once a year we program a course covering basic electricity, electrical-equipment fundamentals, and maintenance and testing procedures. Classes are held once a week, for two hours.

Do you have an electrical safety program?

Electrical safety comes under our regular safety program. Our maintenance groups attend a safety meeting once every three weeks. Electrical safety as well as other accident-prevention rules are discussed at these meetings. My own special rules for electrical safety include: (1) No one but a qualified "A" man can troubleshoot or repair 440-volt equipment. (2) Maintenance men must work in pairs on 440-volt equipment. (3) All 440-volt circuit breakers have interlock keys; maintenance men must lock the breaker off when working on the line. (4) All electrical installations have an equipment ground wire installed in the same raceway with the power legs. This continuous ground wire insures a good ground without depending on the raceway as a conductor.



THREE BUSWAYS, two rated at 480 volts and one rated at 208 volts, extend over the plating area. Central maintenance performs insulation-resistance tests annually. Readings are recorded and compared with previous readings; a continuing downward trend of resistance readings indicates failing insulation.

Conclusion

Electrical maintenance at General Electric's Radio Receiver plant accomplishes its major purpose—downtime is at a minimum resulting in maximum production. But choosing the most effective maintenance system was not a quick decision. For a number of years, Radio Receiver engineers have been studying and revamping their electrical maintenance to ultimately obtain optimum results in their plant. Comparable industries may find Radio Receiver's system helpful in planning their own maintenance, but each company must make allowances for their own particular circumstances.

Electric Power A Weapon for Peace

At the Watervliet Arsenal, Watervliet, N. Y., a new electrical system provides efficiency and adequacy to keep pace with present and future needs of advancing weapons technology.

By John C. Kacharian, *Chief, Engineering Section, Watervliet Arsenal*

THE Ordnance Corps' center for research, development, engineering, procurement, and prototype manufacture of cannon and components and a facility for engineering of missile components, has completely modernized its exterior electrical distribution facilities. Watervliet Arsenal, Watervliet, N. Y., commanded by Col. Walter M. Tisdale, has completed an electrical modernization program that has eliminated deficient and outmoded facilities. The completed program provides an efficient and adequate electrical system designed to keep pace with the needs of advancing weapons technology.

The years after World War II brought forth many advances in tooling, resulting in machines that could produce more accurate work and take deeper and faster cuts in metals. Other advances such as ceramic tooling and more automation appeared. These innovations greatly improved industrial technology and potential. However, all industry was confronted with a new problem—that of providing for the huge increase in the demand for electric power to operate the new machines. Fortunately, this problem could readily be solved, the greatest obstacle being time. Industry realized that electric power must be increased to the extent that future needs could also be met, without major changes again being necessitated within a few short years.

Watervliet Arsenal was faced with the same problem. As machine tools became outmoded and worn out, the Arsenal's foresighted planners replaced them with new machines that would accomplish Watervliet Arsenal's mission faster, cheaper, and more accurately.

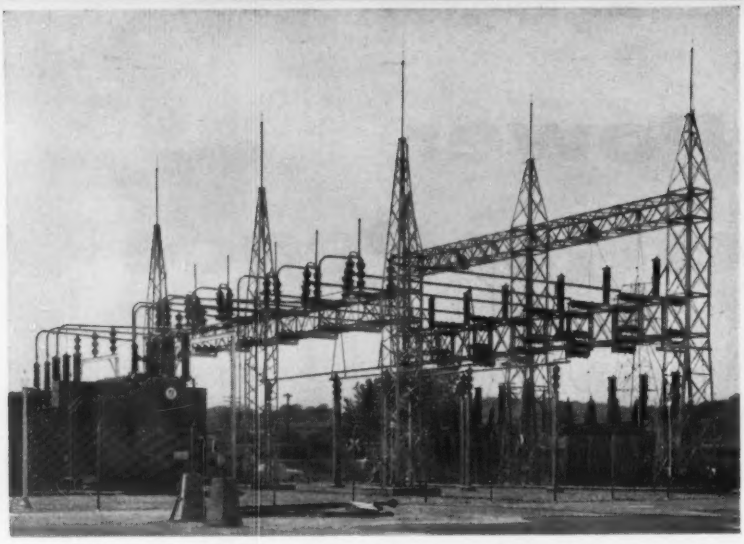
Post Planning Board's Decision

In 1955 the Post Planning Board recognized the Arsenal's need for greater power and decided to obtain an engineering study of the existing electrical distribution system. This study revealed the weaknesses in the system and recommended corrective measures. The Post Planning Board accepted the proposals set forth in the study and initiated a project request to the Chief of Ordnance and the Secretary of Defense. Contract drawings and specifications were authorized in 1956 and were prepared by the architect-engineer firm of Greenberg and Ames, New York City. This firm

PRE-CAST MANHOLES for underground power and communication lines were provided by contractor. The manholes were then transported to the job site.

BORING MACHINE simplifies the installation of underground ducts beneath railroad tracks. The machine bored through tough shale as can be seen in the photo.

UNDERGROUND CONDUITS for 13.2 kv power supply are 4-in. fiber ducts encased in concrete. Spare ducts have been provided for future use.



INCOMING PRIMARY SUPPLY to the Watervliet Arsenal is 115 kv on a double circuit. The master substation contains two 15,000-kva transformers where voltage is reduced from 115 kv to 13.8 kv.

had also prepared the engineering study. Both the study and final plans were developed under the supervision of the District Engineer, New York District. Funds for construction were authorized late in 1958, and the contract was awarded in January, 1959, to Nager Electric Company, Brooklyn, N. Y.

Former Distribution System

Parts of the former, deficient system were installed prior to World War I and some additions were made during both World Wars as new buildings were built. The system was a 3-wire, one-circuit, 13,200-volt network. The shortcomings of the system were many but basically two major conditions existed. First, there was insufficient capacity to provide adequate power for other than limited operations. Second, a breakdown in any part of the distribution would have knocked out approximately one half of the installation.

The line capacity of the system was 7000 kva. During World War II the maximum demand reached 6400 kva and today's demand, with restricted peacetime activity only, but with vastly improved tooling, is approximately 5000 kva. Even a small increase in activity would have caused a dangerous approach to the limit of the system. The 7000-kva capacity was also dependent upon the two sources presently feeding the line and failure of one source would have caused drastic voltage drop in the long single circuit, thus requiring curtailed use of machine tools and research equipment. Another serious shortcoming of the system was that there were only six substations to carry the load of 77 buildings and exterior lighting. If one substation was out of service, power would have been interrupted to many buildings until repairs could be made. Power disruptions ranged from the entry of squirrels into the structures to damaging effects of snow and ice during the extreme winter conditions experienced in this area. Additions were made to the distribution system from time to time, usually during national emergencies, with the result that there was a wide variety of electric equipment representing many manufacturers. The attempt to obtain compatibility of components had always been a problem and very often required great ingenuity to produce a working system. The resulting "mongrel" system was costly to maintain since maintenance procedures were varied throughout the system, and procurement of replacement parts, especially in the older portions of the installation, was difficult to attain.

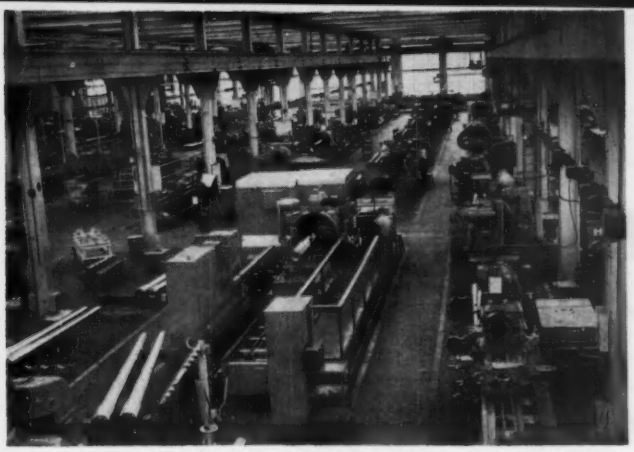
New System

The new system is designed to overcome the deficiencies of the former system by being able to provide adequate capacity, high efficiency and a versatile distribution network.

Electric power is being brought in from the Niagara-Mohawk Power Company's main line located approximately half a mile from the Arsenal, on a double circuit. Line voltage to the master substation is 115,000 volts. The main advantage of taking power at such a high voltage is that there is a high potential of electrical force behind the substation thus preventing drops in voltage from affecting the Arsenal equipment loads. Another advantage is that the power company rates are available at a reduced cost, resulting in a savings to the government. The main line has been installed by the power company to serve the many industries in the area.

Three 57-ft-high towers intercept the high tension line at the substation, and from there the cable drops to circuit breakers and then to three other towers 45 ft high, on which the lightning mast and disconnect switches are located. From this point, power enters the remaining distribution gear in the substation. The main transformer substation contains equipment to reduce the 115,000 volts to 13,200 volts, which is the distributing voltage for the Arsenal. Adequate line capacity is supplied by two 15,000-kva, 3-phase transformers capable of providing 30,000 kva under normal conditions and ultimately can furnish 45,000 kva with the use of fans for forced-air cooling. Fans, however, will not be installed until a future need requires them. Other components comprising the substation are air-break switches, lightning arresters, coupling capacitors, wave traps, circuit breakers, and control and protective relays.

The distribution system is a three-circuit network, each loop being a 3-phase, 13.2/7.6 kv grounded-wye loop made up of two 3-conductor 15-kv cables. Underground conduits carrying the cable are 4-in. fiber ducts encased in concrete. Each circuit also contains spare ducts for future use. The circuits enter concrete manholes at intervals not exceeding 400 ft and wherever there are excessive bends in the system. Power manholes are 8 ft square and 6 ft deep, each weighing approximately 22 tons. The contractor was given the option of building forms for the manholes and pouring concrete in place or pre-casting the manholes and transporting them to their ultimate location. He chose the latter method. Manhole bases with keyways were poured in-place, however, and the joint sealed after the manhole was set on the base.



TYPICAL PILOT LINE BUILDING shows the multitude of machinery required in the Watervliet Arsenal. Notice the abundance of horizontal busway throughout the plant that supplies 440-volt motor equipment.

UNIT SUBSTATION is typical of 18 such units attached to the 13.2-kv primary loop. Voltage at each substation is reduced from 13.2 kv to 440 volts, which supplies machine tools and research and engineering equipment. Lighting voltage is reduced to 208Y/120 at each building.

Attached to the loops are 18 unit substations containing metal-clad switchgear. Power from the loops enters the stations at 13,200 volts, is reduced to 440 volts, and is then distributed to the buildings for energizing machine tools and research and engineering equipment. Lighting voltage is 208Y/120. Each of the 18 unit substations controls a small number of buildings as compared to the old system where six substations controlled everything. With the new system, should trouble occur in the station or in the cable to the building, only a small portion of the Arsenal facilities will be interrupted and the source of trouble can easily be located and repaired in the unit substation or the cables. In addition, each station has a sectionalizing switch which permits the isolation of the station from the remainder of the loop without interrupting power supply to the other unit stations. Another very important advantage in using 18 unit substations is that the power distribution to the buildings is closer to the load centers. This prevents excessive voltage drops that would result from long runs. It also reduces the size of cable required. Maintaining of a voltage without fluctuation is especially important in the operation of research and engineering equipment and the problem of voltage variation has been virtually eliminated. Stubs have been provided in the manholes to connect to seven additional unit substations, which are to be installed with future facility construction.

As part of the electrical modernization program, the existing security and street lighting system was replaced. The outmoded system consisted of fixtures mounted on walls, buildings and poles. Many of the fixtures were spotlights and some were goosenecks. This was a system lacking pattern of installation and lacking sufficient design and quantity. As a need arose in a specific area, a fixture was mounted with a separate switch and power taken from the nearest building. As a result, there were approximately 70 switches on the system and the daily task of turning these switches on and off was time consuming and tedious. Singular control was impossible to attain. Security lights on the perimeter were operated by few switches but lacked coordinated control and sufficient numbers.

The new system is divided into two groups—security and street lighting, and special area lighting such as for the railroad yard, storage areas, and parking areas. The security and street lighting will normally be operated by two photoelectric cells. Each cell controls one half of the lights—alternating fixtures on the two cables. Wiring for lighting is direct series-connected, neoprene-jacketed, direct-burial cable. Fixtures are 6000-lumen lights mounted on building brackets or aluminum poles, spaced at regular intervals and at corners of streets. Dark areas previously existing have been eliminated. Special area lighting is on the same circuit, but fixtures are operated by switches on the poles as required.

The entire lighting system is connected to one switch located in the main police gatehouse. This switch, to be operated only in the event of a national emergency, will turn off all of the exterior lighting. Another feature of the lighting system is the gasoline-powered, 50-kw emergency generator designed to cut-in automatically and operate all of the exterior security lighting should there be a power failure in the normal power company supply. Security will be maintained in any event.

Communications

Trenches dug for the electrical distribution system will also be used for installation of communications ducts and manholes. Cable is not to be installed, however, until the over-all communications improvement project, scheduled for fiscal year 1961, is approved for accomplishment. Proposed improvement will include redistribution of lines to shift additional communications service to the heavily burdened areas now restricted due to lack of cables. The capacity of the system will be increased slightly also.

With the completion of this project, Watervliet Arsenal has achieved a major stride in preparing to fulfill any assigned mission to provide weapons for maintaining peace. Modern tooling and research equipment combined with the modern electrical power facilities needed to operate them produces the combination needed to maintain technological supremacy.

The project, contracted in the amount of $2,086,000, was under the administration and supervision of Col. C. M. Duke, District Engineer, New York District Corps of Engineers; C. Roe was the Resident Engineer with C. Kirschenbaum, his assistant. Arsenal coordination was effected by Lt. Col. J. G. Short, CE, Post Engineer, R. L. Gore, and the author.

Estimating Electric Heating Consumption

in commercial and industrial buildings

A systematic approach to calculating annual energy based on average outdoor temperatures and anticipated heat gains.

By W. J. Keller, *Louisiana Power & Light Co., New Orleans, La.*

BECAUSE of relatively high heat losses in commercial and industrial buildings and the many variables introduced by the specific functions performed within the buildings, the use of simple rule-of-thumb formulas for estimating annual heating energy can lead to grossly inaccurate results.

The NEMA formula[1], extensively used for estimating residential consumption, is also frequently applied to commercial and industrial buildings. The accuracy of such an estimate depends upon how good a guess is made as to the value of the "C" constant[2]. Errors in the value of "C" for residential occupancies have been minimized through experience with standard construction techniques and insulation uniformity. However, this formula cannot be expected to account for the many variables of other building types.

Estimators using such short-cut methods tend to be ultra-conservative, arguing that the customer will be pleasantly surprised to find his costs less than predicted. But incorrect estimates, high or low, can hinder sales. If the original cost figure given proves to be greatly underestimated, the customer will be unhappy. If it is erroneously high, the sale may be lost needlessly. The "time-temperature" method described here fills the need for an accurate estimating method for such non-residential buildings.

Time-Temperature Method

The NEMA formula, through its C-constant, attempts to modify the design heat loss to account for actual outdoor temperatures and heat gains within the structure which help to offset the heating requirements. The time-temperature method investigates these variations in outdoor temperature and heat gains systematically.

Design heat loss is normally calculated in Btu/hr. The electrical equivalent of Btu/hr is watts, which may be expressed as watthours/hr, or kilowatthours/hr, to introduce the concept of time.

Design heat loss is based on the design temperature difference, which is the difference between the indoor temperature and the outside design temperature. However, the *actual* heat loss for any specific hour must be based on the actual temperature difference existing during that hour. If we take the kwhr/hr heat loss for that hour, multiply it by the number of hours during the heating season that such a temperature difference exists, we will have the total seasonal heat loss in kwhr for that temperature difference.

By making such an evaluation for a selected number of temperature differences covering the range applicable to the geographical location, we will have the total energy loss for the heating season. Since energy supplied must equal energy lost, this figure also represents the gross heating requirement for the season. The net heating requirement may then be found by subtracting from this figure the expected heat gains during the heating season.

The process, then, requires that the following be known: (1) total design heat loss of the structure; (2) breakdown of winter temperatures for the specific city or area involved; and (3) evaluation of heat gains.

Heat Loss

The design heat loss may be calculated following standard procedures as outlined in the *ASHRAE Guide*, the *NEMA Manual*, or other similar publications. Assume for example that we are to estimate the consumption for a commercial building whose design heat loss has been calculated as 273,000 Btu/hr, or 80 kw, at an outside design temperature of 20F. The inside temperature is to be maintained at 70F; therefore, the design temperature difference is 50 degrees.

To facilitate calculations and to avoid confusion between heat loss, equipment sizing, and demand, we may express this 80-kw heat loss as 80 kwhr/hr, as explained above. Thus 80 kwhr/hr can be used by 80 kw of equipment operating 100% of the time for one hour, or by 100 kw operating for 80% of the time (42 minutes per hr).

Since heat loss is directly proportional to the outdoor temperature, we may plot kwhr/hr against outdoor temperature as a straight line. We know that the loss at 20F is 80 kwhr/hr, and the loss at 70F is zero. Therefore we may set up two scales, kwhr/hr and temperature, plot these two points, and draw a straight line connecting the points. The result is shown in Fig. 1.

Using Fig. 1, we can pick off the heat loss of our building for any existing outdoor temperature. At 42F, for example, the loss is 44.8 kwhr/hr. Thus if the outdoor temperature were maintained at 42F for one hour, we would have to supply 44.8 kwhr/hr × 1 hr or 44.8 kwhr to offset the heat loss. For ten hours, we would require 44.8 kwhr/hr × 10 hr or 448 kwhr.

One other consideration should be mentioned. Since many commercial and industrial buildings employ automatic ventilating equipment, the heat withdrawn from the heated space per hour by such equipment must be included in the design heat loss figure.

Outdoor Temperature

Accurate data is needed which gives the total duration of each outdoor temperature over the heating season. Such data can be obtained from the U. S. Weather Bureau through its publications on climatography. Five-year summaries are available for many weather stations. These summaries show the number of temperature observations taken in each 5-degree group. Local weather bureaus should be able to supply such information, or it may be requested directly from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Table 1 has been compiled for New Orleans from one such publication[3]. It gives 5-year averages. For example, there were 1215 observations in the 40 to 44F group over a 5-year period; therefore, the average per year is 1215/5 or 243. In other words, during an average winter, temperatures of 40 to 44F occur 243 times. Since these readings are taken hourly, we may assume, with some small error, that each one indicates an hour at that temperature.

Only one further assumption is necessary. Since the mean of this 40 to 44F group is 42F, we will assume that there is an average of 243 hours per winter at 42F. From Fig. 1, we see that the heat loss from our hypothetical building would be 44.8 kwhr/hr at 42F. Thus the total seasonal heat loss at 42F would be 44.8 kwhr/hr × 243 hr or 10,886 kwhr.

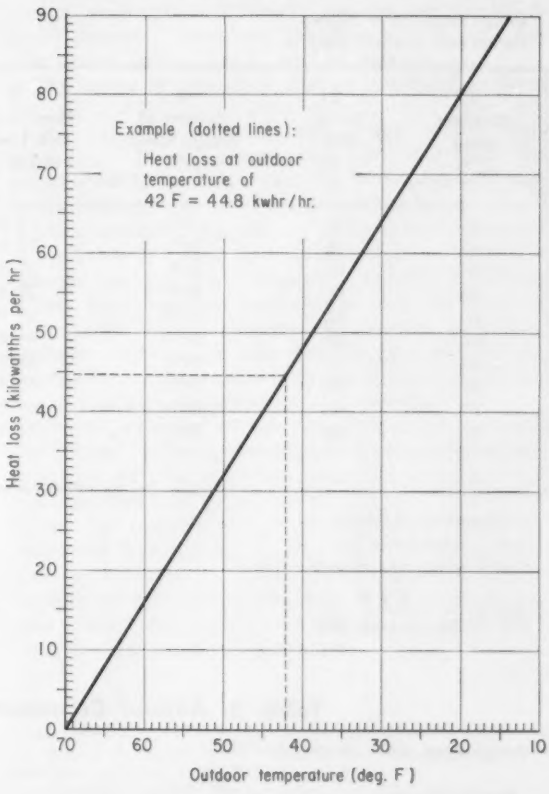
Obviously, by repeating this process for each of the temperatures of Table 1, we can determine the total seasonal energy requirement for the building for an average winter.

Heat Gains

Internal gains are likely to be large in commercial and industrial structures. They are important in this method and should be figured accurately.

In the building of our example, assume we have 16 kw in lighting and miscellaneous power and the average number of people occupying the building at one time is 27. At 500 Btu/hr per person, this

FIG. 1. Outdoor Temperature vs Heat Loss



adds up to 4 kw. The total heat gain is thus 16 plus 4 or 20 kwhr/hr, and operation of the building's heating equipment would be necessary only when the heat loss exceeded 20 kwhr/hr.

Total Energy

The preceding considerations should be arranged in a heating estimate form, as shown in Table 2. Note that columns 1 and 6 are taken directly from Table 1; these columns will remain the same for all heating estimates made in the same area. Column 3

Table 1. Outdoor Temperatures, New Orleans (October through April; 5-Year Average)

Temperature range (°F)	Mean temperature (°F)	Hours per year
70–74	72	722
65–69	67	887
60–64	62	793
55–59	57	716
50–54	52	555
45–49	47	448
40–44	42	243
35–39	37	94
30–34	32	18
25–29	27	7
20–24	22	6

Table 2. Annual Consumption, Continuous Operation

Design temp. diff. = 50 deg.
Design heat loss = 80 kwhr/hr

Internal heat gains = 20 kwhr/hr
Inside design temp. = 70 F

1 Outdoor temp. (°F)	2 Temp. diff. (°F)	3 Percent of design temp. diff.	4 Heat Loss at Col. 1 temp. (kwhr/hr)	5 Heat loss less internal heat gains (kwhr/hr)	6 Duration of Col. 1 temp. (hr/yr)	7 Heating energy (kwhr/yr)
67	3	6%	4.8	....	887	....
62	8	16%	12.8	....	793	....
57	13	26%	20.8	0.8	716	572
52	18	36%	28.8	8.8	555	4900
47	23	46%	36.8	16.8	448	7520
42	28	56%	44.8	24.8	243	6050
37	33	66%	52.8	32.8	94	3080
32	38	76%	60.8	40.8	18	735
27	43	86%	68.8	48.8	7	340
22	48	96%	76.8	56.8	6	340
					Total annual kwhr = 22,537	

Explanation of table:
Col. 1: From Table 1.
Col. 2: Inside design temp.—Col. 1.
Col. 3: $\frac{\text{Col. 2}}{\text{Design temp. diff.}}$
Col. 4: Col. 3 (expressed as decimal) x Design heat loss
Col. 5: Col. 4—Internal heat gains.
Col. 6: From Table 1.
Col. 7: Col. 5 x Col. 6.

Table 3. Annual Consumption with Thermostat Setback

Design temp. diff. = 50 deg. at 70F
35 deg. at 55F
Design heat loss = 80 kwhr/hr at 70F
56 kwhr/hr at 55F

Internal heat gains = 20 kwhr/hr at 70F
0 at 55F
Inside design temp. = 70F 33% of time
55F 67% of time

1 Outdoor temp. (°F)	2 Temp. diff. (°F)	3 Percent of design temp. diff.	4 Heat loss at Col. 1 temp. (kwhr/hr)	5 Heat loss less internal heat gains (kwhr/hr)	6 Duration of Col. 1 temp. (hr/yr)	7 Heating energy (kwhr/yr)
Inside design temp. = 70F						
67	3	6	4.8	....	293	....
62	8	16	12.8	....	264	....
57	13	26	20.8	0.8	239	190
52	18	36	28.8	8.8	185	1630
47	23	46	36.8	16.8	149	2520
42	28	56	44.8	24.8	81	2040
37	33	66	52.8	32.8	31	985
32	38	76	60.8	40.8	6	245
27	43	86	68.8	48.8	2	100
22	48	96	76.8	56.8	2	115
					Kwhr at 70F:	**7,825**
Inside design temp. = 55F						
67	....	....	....	....	594	....
62	....	....	....	....	529	....
57	....	....	....	....	477	....
52	3	9	5.4	5.4	370	2000
47	8	23	12.9	12.9	299	3860
42	13	37	20.7	20.7	162	3360
37	18	52	29.1	29.1	63	1835
32	23	66	37.0	37.0	12	445
27	28	80	44.8	44.8	5	225
22	33	94	52.6	52.6	4	210
					Kwhr at 55F:	**11,935**
					Total annual kwhr:	**19,760**

will remain the same for all installations with an indoor design temperature of 70F. The remaining columns are calculated for each job as explained beneath the table. The total of column 7 is the annual kwhr consumption *assuming 24-hr-per-day operation of the building.*

For other than continuous operation, suitable modifications must be made. Where buildings are used for only 8 to 10 hours a day, for example, considerable economy can result from setting the thermostats lower for the remaining hours.

Assume, for example, that careful calculation shows that in our building the 70F temperature need be maintained only 33% of the time, and that 55F may be maintained for the remaining time. The hours at 55F are made up of the nights of working days plus both days and nights of Saturdays, Sundays, and holidays. Therefore, it may be assumed that the hours of setback are distributed proportionately among all the temperature ranges. (It would be extremely impractical to attempt to otherwise match up the setback hours with specific temperatures.) In figuring the percentage of time at each inside temperature, no allowance need be made for extra consumption to account for morning pickup when the 70F temperature is restored, due to the beneficial thermal storage capabilities of the building while the temperature is dropping from 70F to 55F in the evening. (However, if the heating system were to be completely shut off during this period, some consideration would have to be given to this added consumption. Lacking more accurate data, an extra hour per day may be added to the 70F time.)

Table 2 must now be modified to reflect this period at 55F, as shown in Table 3. For convenience, the table is broken down into two parts, one for each inside temperature condition. Note that the design temperature difference for the 55F condition is 35 degrees; therefore, the design heat loss for this period (from Fig. 1) will be 56 kwhr/hr.

The values in Column 6 must be calculated to show the 33%-67% temperature relationship. For example, Table 1 gives 243 hr/yr at 42F outside temperature. Inside temperature of 70F will be maintained 33% of this time, or 81 hours; 55F will be maintained 67% of this time, or 162 hours.

The remaining columns of Table 3 are calculated as in Table 2, except that no allowance is made for internal heat gains in Column 5 at the 55F condition.

The total heating requirement for the year is thus 19,760 kwhr following the setback procedure outlined. Obviously, this method provides an opportunity to investigate probable heating costs for various setback temperatures and schedules.

The inaccuracies of the time-temperature method are limited to the assumptions of people loads, the deviation of the weather from the average, and the beneficial heat gains due to the sun. This latter factor, not considered in the above, will reduce the estimated consumption by an unknown amount, putting the estimate on the conservative side. Accurate records of energy consumption of all jobs in one area after installation can help to provide solar data to improve future estimates.

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[1] Kwhr = kw x DD x C/TD. See NEMA publication HE-1-1957; and "A Manual of Electric Space Heating," *Electrical Construction and Maintenance*, March, 1960.

[2] See "Design Heat Loss and the NEMA Constant," EHF No. 1, July 1960.

[3] "Summary of Hourly Observations, New Orleans, La., Climatography of the United States No. 30-16."

Humidity and Condensation—III

Factors affecting penetration of water vapor into walls, floors, and ceilings of the electrically heated home.

By W. J. Novak

THE presence of moisture in any significant quantity inside walls (or in crawl spaces and attics) can be responsible for rotting away wooden framing, corroding metal members, reducing insulation effectiveness, and staining or blistering paint on the outside of a house. That the possibility of such damage is greater in an insulated structure than in one without insulation (or with less insulation) can be understood only by appreciating the factors determining changes in temperature and vapor pressure within the wall, ceiling or floor cavity and the flow of vapor through the building materials.

Since the basic analysis is the same for walls, ceilings, and floors, only the wall will be treated here.

How does the temperature vary through a wall? Logic tells us that wall surfaces close to the heated room will be warmer than those close to the cold outdoors. Actual measurements made through the wall cross-section would show that the temperature drops progressively from indoors to outdoors. However, it does not drop uniformly. For example, if we have a wall seven inches thick with temperatures of 70F inside and zero outside, we cannot say that the temperature drops 10 degrees per inch of thickness.

The actual temperature drop through the wall is determined by the thermal resistances of the materials making up the wall. If a material conducts heat readily, the temperature difference between the inside

and outside surfaces of the material will be small. However, a material with a high thermal resistance will block the flow of heat more effectively; and its outside surface, since it receives less conducted heat, will be cooler.

The temperature drop (TD_x) from the inside air to any surface (x) within the wall is directly proportional to the thermal resistance (R_x) encountered by the passage of heat from the inside air to that surface. Since we know the total temperature difference (TD_t) between the inside air and outside air, and we know the total thermal resistance (R_t) of the wall[1], we can set up a formula to express this proportional relationship:

$$\frac{TD_x}{R_x} = \frac{TD_t}{R_t}$$

$$\text{or } TD_x = R_x \frac{TD_t}{R_t}$$

Solving for TD_x will give the temperature at surface x.

Example 1: Assume we have an uninsulated frame wall as pictured below, with air temperatures and resistance values as shown. Calculate the temperature at (a) the inside surface of the wall, (b) the outside surface of the gypsum board, (c) the inside surface of the sheathing, (d) the outside surface of the sheathing, (e) the inside surface of the siding, and (f) the outside surface of the wall.

Solution: Total temperature difference $TD_t = 70\text{-}0 = 70$ deg. Total resistance $R_t = 3.28$.

$R_a = 0.68$
$R_b = 0.68 + 0.32 = 1.00$
$R_c = 1.00 + 0.86 = 1.86$
$R_d = 1.86 + 0.98 = 2.84$
$R_e = 2.84 + 0.06 = 2.90$
$R_f = 2.90 + 0.21 = 3.11$

Substituting these values in the formula gives the following temperature differences:

$TD_a = 0.68 \times 70/3.28 = 0.68 \times 21.34 = 14.5$ deg.
$TD_b = 1.00 \times 21.34 = 21.3$ deg.
$TD_c = 1.86 \times 21.34 = 39.7$ deg.
$TD_d = 2.84 \times 21.34 = 60.6$ deg.
$TD_e = 2.90 \times 21.34 = 61.9$ deg.
$TD_f = 3.11 \times 21.34 = 66.4$ deg.

The temperature at each surface may now be found by subtracting each of these temperature differences from the room air temperature:

$t_a = 70 - 14.5 = 55.5$F
$t_b = 70 - 21.3 = 48.7$F
$t_c = 70 - 39.7 = 30.3$F
$t_d = 70 - 60.6 = 9.3$F
$t_e = 70 - 61.9 = 8.1$F
$t_f = 70 - 66.4 = 3.6$F

These results, plotted against the wall thickness as shown in an accompanying illustration, give a graphical picture of the drop in temperature from inside air to outside air.

Example 2: How do these results differ if the wall air space is filled with insulation having an R-value of 13.41?

Solution: TD_t remains at 70 deg. as before. $R_t = 3.28\text{-}0.86$ (air space) + 13.41 (insulation) = 15.83. Duplicating the process given in Example 1 gives the following results:

Surface	R	TD	t
a	.68	3.0	67F
b	1.00	4.4	65.6F
c	14.41	63.7	6.3F
d	15.39	68.0	2.0F
e	15.45	68.3	1.7F
f	15.66	69.2	0.8F

These temperatures, plotted as in Example 1, show that the insulation used has increased the temperatures of the surfaces close to the inside space and decreased those of the surfaces close to the outside.

What does this temperature drop through the wall have to do with moisture? As previously explained, moisture will condense out in a space when the temperature reaches the dew point of the vapor within the space. Thus if the dew point at any point within the wall is lower than the temperature at that point, condensation can be expected.

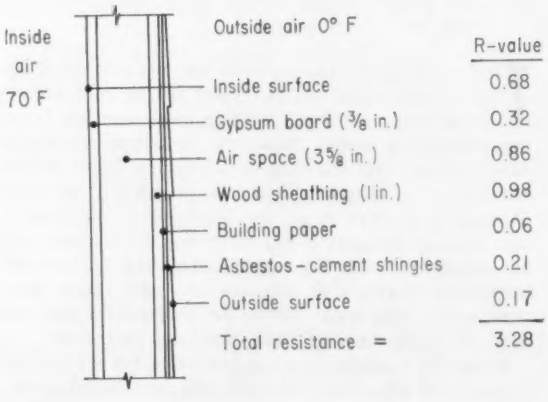
The dew-point temperature at any point within a wall depends upon the relative humidities and air temperatures inside and outside the heated space and their associated vapor pressures[2]. The vapor pressure at any point within the wall can be found in a manner similar to that used to find the temperatures in the above examples. Once the vapor pressure at a point is known, the dew-point temperature at that point is also known.

It isn't necessary here to go into this process of determining dew points. Assume, however, it has been found that given conditions of temperature and humidity indicate that the dew-point temperature in the wall stud space is 30F. (This will apply to both the insulated and uninsulated walls, since the insulation has just about the same effect on vapor pressure as the air space.)

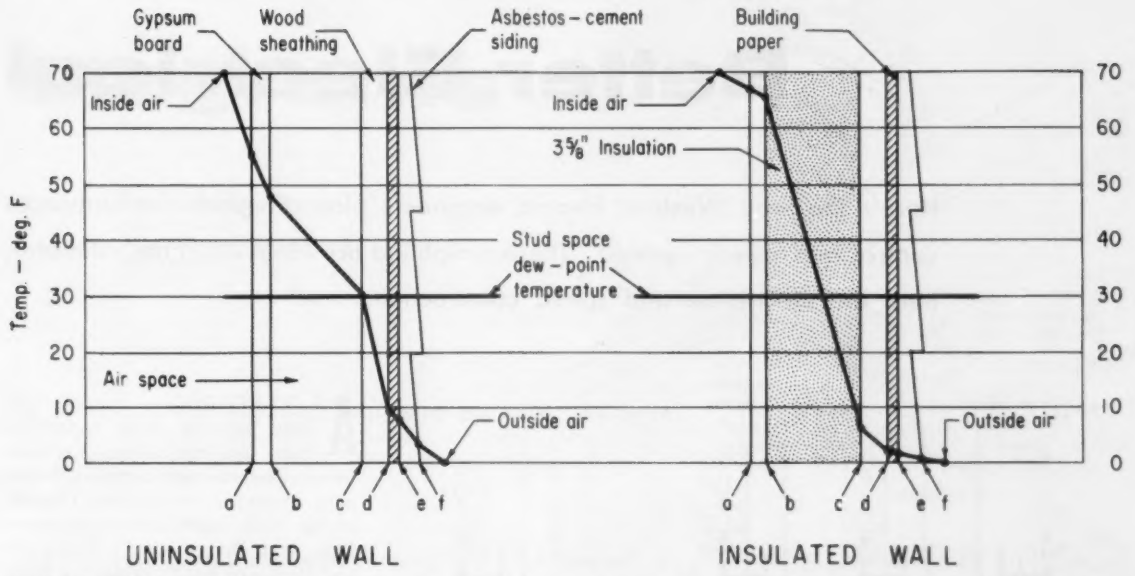
The temperature curve of the uninsulated wall shows that the temperature is above 30F across the entire stud space (between surfaces b and c); therefore, condensation will not take place here. However, in the insulated wall, the temperature in the stud space reaches 30F within the insulation. Thus any water vapor entering the wall will very likely condense within the insulation. The additional drawings given show how increased insulation affects this condition.

Both the specific amount of water vapor which enters the wall and the pressure exerted on this vapor within the wall depend upon the relative re-

Thermal Resistance of Uninsulated Frame Wall



Temperature Drop Through Frame Walls



CONDENSATION OF MOISTURE within walls is most likely to occur on the surfaces of the sheathing and the siding, since lowest temperatures exist at these points. The addition of insulation in the stud space blocks the flow of heat to the outside; therefore, these surfaces will be colder than in an uninsulated wall. These drawings show that condensation is not likely to occur in an uninsulated wall with a stud-space dew-point temperature of 30F. But in an insulated wall, the temperature falls below the dew point somewhere within the insulation, thus promoting condensation at that point.

In very cold weather at high outdoor relative humidities, stud-space dew-point temperatures are likely to be 40F or higher if suitable vapor barriers are not installed on the warm side of the wall.

sistances of the building materials to water vapor penetration. The gypsum board, air space and insulation of the wall considered above have relatively low vapor resistance compared with the remaining materials; therefore, most of the pressure drop from inside to outside occurs across the sheathing, building paper, and siding. This means that vapor travels as far as the sheathing with comparative ease, but it encounters considerable resistance in finding its way to the outside. Thus vapor is entering the wall at a faster rate than it is leaving, and an accumulation results.

To alleviate this condition, some means must be adopted to slow down the entrance of vapor into the wall.

[1] See "Calculating Heat Loss Factors," EHF No. 2, August, 1960.
[2] See "Humidity and Condensation—II," EHF No. 9, March, 1961.

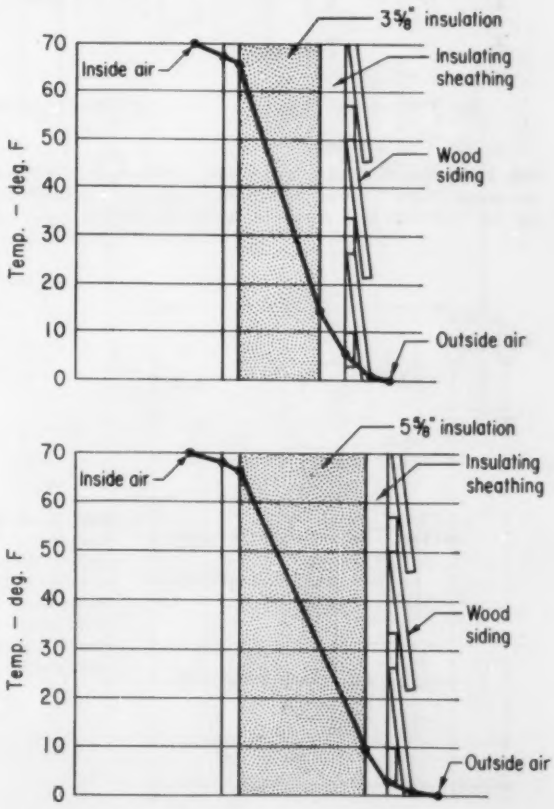
June Issue: Installation of Vapor Barriers

REPLACING the wood sheathing and asbestos-cement siding with the commonly used insulating board sheathing and wood siding with insulating backer board (top) increases the thermal resistance of the **outer** portion of the wall, raising the temperatures of the sheathing surfaces slightly. A suitably treated outside surface of the sheathing eliminates the need for building paper in many cases.

Increasing wall thickness to accommodate 5⅜ inches of insulation (bottom) increases the thermal resistance of the **inner** portion of the wall, thus reducing the temperature of the sheathing surfaces.

These trends in modern construction of electrically heated homes decrease heat loss and increase living comfort by raising the inside surface temperature of the wall, but dangerously low temperatures of the outer portions of the wall promote condensation if excellent vapor barrier protection is not provided.

Effect of Insulation on Wall Temperatures



How to prepare . . .

Better Electrical

Here's the way Western Electric engineers plan diagrams for elaborate control and power systems. These simplified drawings assist the estimator, help the electrician and speed construction.

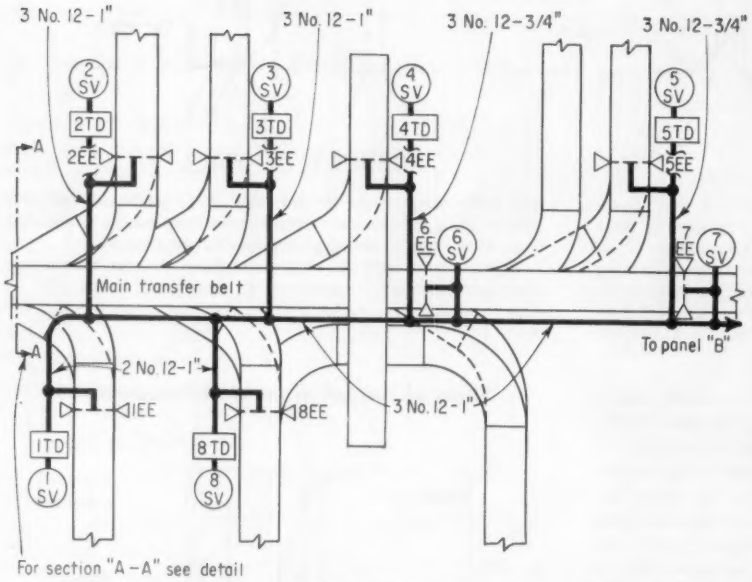


FIG. 2—Portion of conduit layout shows conduit runs "darkened" while "landmarks" are drawn "light." Notice that conduit sizes and the number and size of wires to be run are indicated. Only pertinent details are shown.

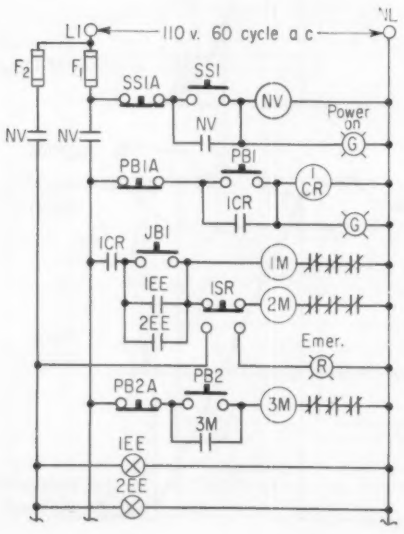


FIG. 3—Elementary diagram tells how the circuit works, what path current takes in causing the circuit to work, and the general scheme of things from the standpoint of electrical action. This diagram helps the electrician locate electrical trouble-spots quickly.

AS ELECTRICAL control systems become more extensive, their accompanying diagrams become increasingly complex. In the past, electrical control was thought of as "Joe, start this conveyer—Sam, stop that motor." Today Joe and Sam are gone; replacing them are integrated systems, which automatically control scores of motors and complex devices. Because time and labor spent on a single automated system may be extremely costly, we at Western Electric looked for a way to save money for the electrical contractor. Clear diagrams and accurate drawings are one answer. Why? Because practically all errors in installation, equipment selection and estimating as well as wasted time are due to confusion and misunderstanding of drawings.

Our engineers, seeing this need for better electrical diagrams, decided to improve the design of their drawings.

To the engineer, the order of importance of diagrams is the same as the order of design. When he designs an electrical control system, the engineer normally starts with the elementary diagram. Next he completes the wiring diagram. Finally, conduit layout drawings are done. However, to the electrical contractor the order of importance is reversed. The installation drawing comes first, and the elementary drawing is last. From installation drawings, the electrical contractor can obtain his basic "picture" of the job. Often a major portion of the cost-estimate is taken from the installation drawing. Therefore, the design engineer must prepare drawings that give precise information.

To help our people design better electrical diagrams, we instruct them as follows:

Diagrams

By Posheng Yen
Plant Engineer
Western Electric Company
New York, N. Y.

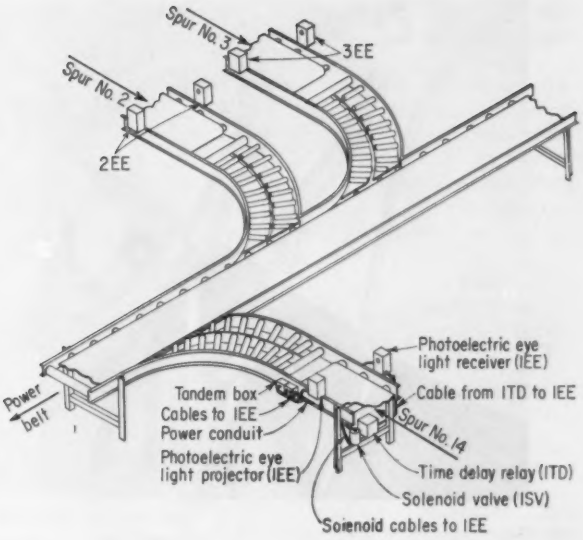


FIG. 1—Isometric view shows special installation details. Dimensions and ratings are not indicated. An isometric view provides the electrician with a "photograph" which identifies and locates components.

Use whatever means is necessary to convey information. If a "note" informs better than a diagram, then furnish a note. If an isometric view is clearer than a plan view, then an isometric view should be provided. (Fig. 1 shows a typical isometric view.) After all, drafting time is cheap compared to an inaccurate estimate or installation errors with the resulting wasted time and money.

Don't hesitate to use an "oversize" scale on a drawing if it will make things clearer for the reader. Drawings that are cluttered with various control equipment, conduit runs, etc., even though each are properly designated, tend to confuse the reader. "Over-sizing" will usually require more drawings, but the number is insignificant if the result is clearer interpretation.

Any system, no matter how complex, can be broken up into different areas, sections or sub-systems. It is much better to have many drawings of several phases than to have a few drawings attempt to encompass the entire system.

Installation drawings and/or conduit-layout drawings (Fig. 2) show conduit runs; locate and identify equipment; and reveal the general scope of work to be done. In a major installation there are numerous sheets of these drawings.

When you design conduit layouts, keep the following pointers in mind:

Each drawing should be planned independently. Visualize the probable installation sequence and "break down" the drawings accordingly. Show all power sources and pertinent "landmarks" such as racks, benches and columns. Show only what is necessary for clarity, and leave out all other non-pertinent information.

Be certain that conduit runs and equipment outlines are darker than "landmark" outlines. This is important. *Even if nothing else is done to improve your drawing, darkened conduit and equipment lines will make your drawing much clearer and easier to read.* Indicate conduit sizes and the number and sizes of wire to be run in it. Include any special notes or references if an obstacle or difficulty is anticipated. Extremely complicated runs are best shown with an isometric view. And because high conduit runs are more costly than

(Continued on page 168)

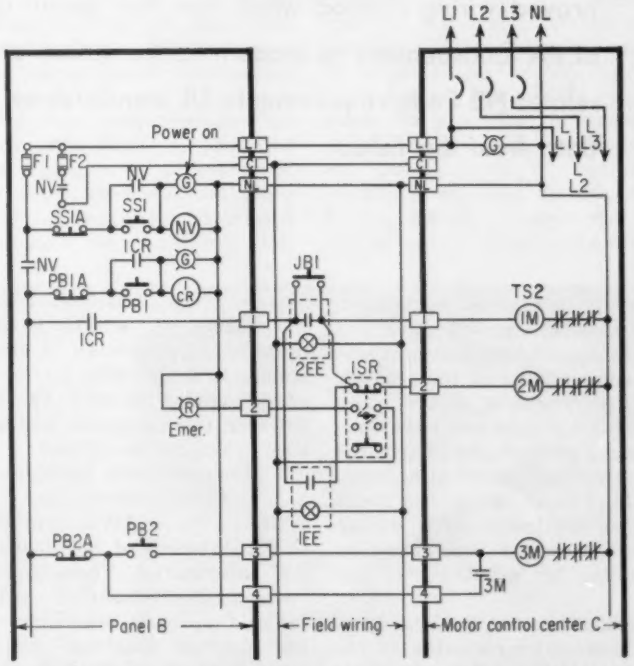
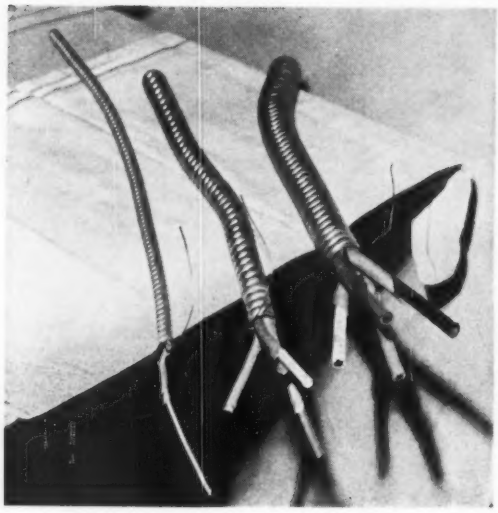


FIG. 4—Revised elementary diagram has all the assets of the one shown in Fig 3. An added feature that makes this diagram a more powerful trouble-shooting tool is that components and wiring locations are shown. Note that it is evident that PB1 is located in Panel B while coil 1M is located in motor control center C.



TYPE ACT CABLES, conforming to the armored cable construction standards of the UL are shown here in typical assemblies: (L-R) 2-conductor, No. 14; 3-conductor, No. 6; 4-conductor, No. 2. Each assembly has impregnated paper wrap on individual TW insulated conductors and includes a No. 16 bonding strip run under the steel armor.

WHAT YOU SHOULD KNOW ABOUT . . .

Armored Cable

A resume of construction and application characteristics on a tested-and-proved wiring method which runs the gamut of circuit use—from hookup of PA loudspeakers to modern 15-kv industrial feeders. This article correlates NE Code requirements, UL standards on the cable and engineering data from the field.

EFFECTIVE design and installation of modern armored cable circuits depend upon a comprehensive understanding of the product. Such understanding should cover construction of the cable, code regulations and performance of armored cable in modern electrical systems. A study of these factors can result in better application of a wiring method which has been, more or less, taken for granted over the years.

Article 334 of the National Electrical Code, which regulates the use of armored cable, defines the product as "a fabricated assembly of insulated conductors and a flexible metallic covering." The common version of this assembly contains the conductors within a jacket made of a spiral-wrap of steel or aluminum strip with interlocking of the edges of the strip. There are, however, two categories into which such cables can be divided:

1. Armored cable assemblies of 2, 3, or 4 conductors in sizes No. 14 AWG to No. 1 AWG, conforming to the standards of the Underwriters' Laboratories. These standards cover multiple-conductor armored cables for use in accordance with the National Electrical Code, in wiring systems of 600 volts or less, at temperatures of 60°C or 75°C depending upon conductor insulation.

2. Armored cables which do not come under the UL standards (although some are listed by UL under Re-examination Service)—commonly called "interlocked armor cable." This includes armored cables in sizes No. 1 or smaller which do not conform to the standard, armored cables with conductors larger than No. 1 and armored cables for use above 75°C and/or for use in systems rated over 600 volts.

UL Type AC

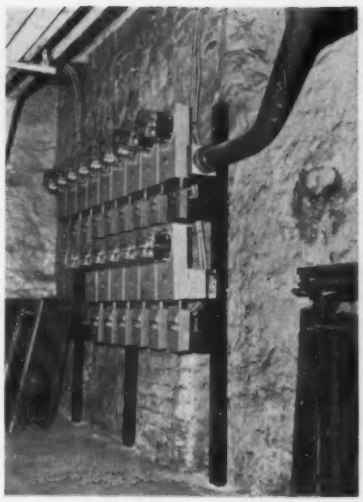
Those armored cables which are listed by manufacturers' names in the Electrical Construction Mate-

rials List of the Underwriters' Laboratories, Inc., are produced under the Factory Inspection and Label Service Program of UL. Under the UL Label Service, the manufacturer attaches labels to his armored cable which has been examined and tested and found to comply with the UL requirements for construction of such cable. In addition, production samples of the cable are inspected frequently at the factory by a representative of the UL to assure compliance with UL standards. A label is wrapped around the cable of each coil, indicating the length of cable in the coil.

Type AC is armored cable with code grade (60°C) rubber-insulated conductors. Type ACT is armored cable with thermoplastic-insulated (Type T) conductors. Type ACH is armored cable with heat-resistant grade (75°C) rubber-insulated conductors. Today, most UL armored cable is of the Type ACT construction with T or TW conductors. Type AC is seldom found, although armored cable with RH-insulated conductors is made for use where the higher temperature rating and/or higher current rating (in sizes No. 8 and larger) is required. An armored cable assembly with lead-covered conductors is designated Type ACL.

The standards for construction and testing of armored cable include the following requirements:

1. The individual conductors of armored cable must be standard thermoplastic-insulated or rubber-covered conductors (T, TW, THW, R, RW, RHW, etc.). Rubber covered conductors must have a moisture-proofed fibrous over-all covering around the grouped conductors of the cable. Thermoplastic-insulated conductors must be individually wrapped with moisture-resistant kraft paper.



ARMORED CABLE FEEDERS, UL type AC, are shown here originating from feeder breakers at a meter bank in the basement of an apartment house. Each No. 8/3 feeder from a 2-pole, 30-amp CB serves one apartment. Armored cable offered particular advantage on this extensive electrical modernization job where flexibility of the cable effected major labor savings in installation.

2. Construction of armored cable must permit ready insertion of an insulating bushing or equivalent protection between the conductors and the armor at each termination of the armor.

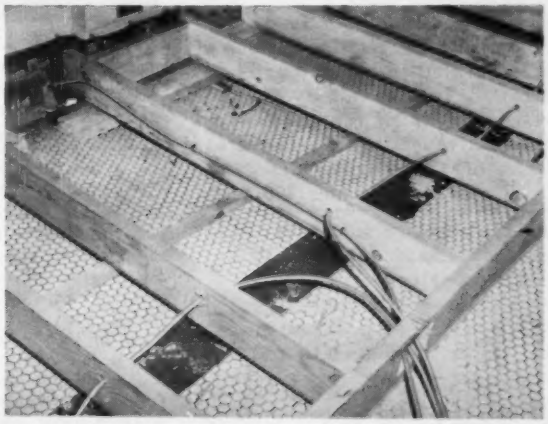
3. The steel strip employed in armored cable must be protected against corrosion by a coating of zinc on all surfaces, including edges. The standard for UL-labeled armored cable recognizes only steel for the armor. Other metallic armors—aluminum, bronze, copper—are not permitted.

4. The ohmic resistance of finished armor, including the bonding conductor which is required to be furnished as a part of all except lead-covered armored cable, shall not be greater than the following values for given sizes of conductors within the armor:

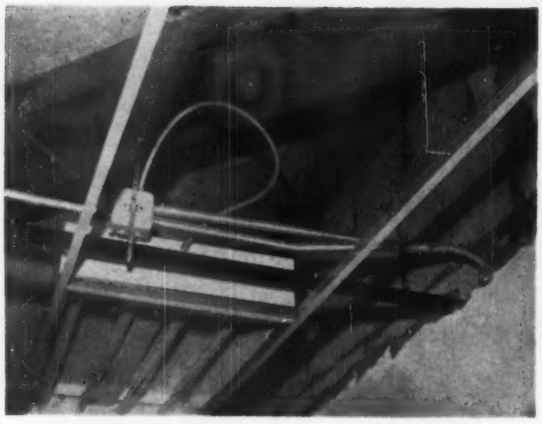
Size of Conductor	Max. Resistance, ohms/100 feet
14	0.75
12	0.64
10	0.56
8	0.45
6	0.38
4	0.30

The bonding conductor run within the armor of the cable assembly is required by the UL standard. The same size of bonding conductor is used in all sizes and makeups of UL-labeled armored cable. The bonding conductor must not be smaller than No. 16 AWG aluminum wire or not smaller than No. 18 AWG if made of tinned or alloy-coated copper.

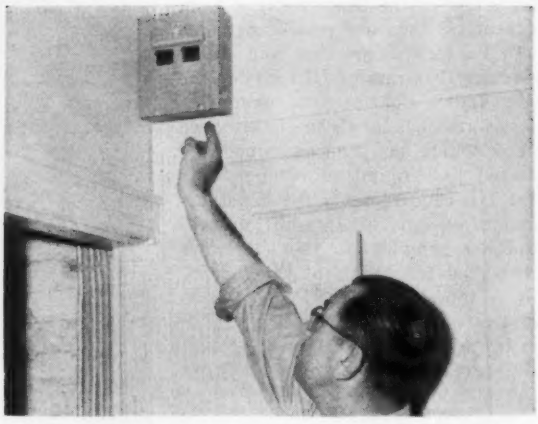
The tabulated maximum values of ohmic resistance for armor plus the bonding strip were established to make the metallic armor suitable as an equipment grounding conductor for use in accordance with the National Electrical Code. Sections 250-1 (b), 250-33 and 250-42 to 250-45 of the NE Code set forth general and specific requirements for grounding of conductor enclosures and non-current-carrying metal parts of equipment (housings, cabinets, frames, etc.). Section 250-51 requires that the path to ground from conductor en-



ELECTRICAL MODERNIZATION of branch circuits can often benefit greatly from the ease of installation of armored cable as shown here where steplights are being wired into the wood frame for a raised platform in renovation of a restaurant.



LUMINAIRE INSTALLATION is another area of branch circuit work where armored cable offers economy and essential flexibility for removing and servicing recessed lighting units. In suspended ceilings, the entire system of branch circuiting, including taps to individual fixtures, may be done with armored cable. Or, armored cable may be used for taps from a junction box to a recessed fixture where the conductors are rated for the temperature in the terminal compartment.



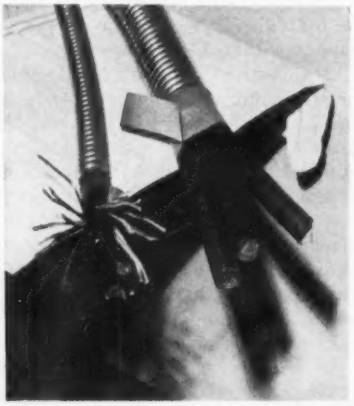
APARTMENT RISERS of No. 10/3 and No. 8/3 type ACT armored cable are shown here run up an abandoned dumbwaiter shaft to supply a circuit breaker panelboard in each apartment along the run. The armored cable for the panel shown here comes through the wall into the side of the panel enclosure.

closures and equipment housings have continuity and sufficient current-carrying capacity to conduct fault currents and have impedance low enough to limit voltage above ground at the point of fault and to permit enough current to flow to operate the overcurrent device in the circuit. Considering all of the foregoing in conjunction with code recognition of cable armor as an equipment grounding path [Section 250-57 (a)] the importance of low armor resistance is obvious.

Although the above listed values of armor resistance satisfy UL requirements, these are merely acceptable limits and are considerably bettered by tight forming and wrapping of the steel band into the cable armor. Overlapping edges of the band should lock tightly with adjacent edges to form a secure interlocked assembly, thereby minimizing the resistance value of the current path through the armor. Typical values of armor resistance which can be achieved by effective locking of armor are:

Size of Conductor	Armor Resistance, ohms/100 feet
14	0.2-0.3
12	0.18-0.25
10	0.16-0.24
8	0.15-0.22
6	0.14-0.21
4	0.13-0.20

These values of resistance are roughly one-third the maximum UL limit and are generally in line with values of ground path resistance according to Table 250-95 of the code. This table shows the minimum sizes of grounding conductors based on use of these conductors to provide a path to ground for conductor enclosures and equipment throughout an electrical system anywhere on the load side of the service equipment. For instance, the table shows that a No. 12 AWG copper wire is the smallest permissible ground wire for equipment supplied by a circuit protected at 40 amp. A No. 12 wire has a dc resistance of 0.169 ohms per 100 ft. If the 40-amp circuit were run with No. 8 conductor armored cable, the armor serving as the equipment grounding conductor would, from the above armor resistance table, have a resistance somewhere between 0.15 and 0.22 ohms per 100 ft. Thus, the ground path resistance for the armored cable is approximately in agreement with the intent of Table 250-95.



INTERLOCKED ARMOR CABLES are made in a wide variety of constructions and sizes of enclosed conductors to meet varying load requirements, ambient temperatures and atmospheric conditions. Two samples shown here are (L-R) 3-conductor No. 2 with varnished cambric insulated conductors and 3-conductor 500MCM with rubber insulated conductors. The No. 2 assembly at left contains jute fillers to fill out the round cross-section of the assembly under the armor. This cable is also provided with three stranded ground cables, each with current capacity of 50% of the phase conductors, to provide a low-impedance ground path for equipment grounding. The assembly at right has only an impregnated moisture-resistant paper wrap over the conductor assembly, with no fillers or ground conductors.

Of course, in all cases of grounding, whether a separate grounding conductor is used or grounding is provided through metal raceway or cable armor, connections in the ground path—at ground conductor lugs, at raceway couplings and terminals or at cable fittings—will add generally indeterminate amounts of resistance. Good workmanship and use of effective products and methods in connections can keep such resistance to a minimum. But it should be noted that the UL values of maximum resistance of cable armor are far in excess of maximum equipment ground conductor resistances implied by Table 250-95 to be effective.

The importance of sufficiently low impedance of the ground return path is particularly important in

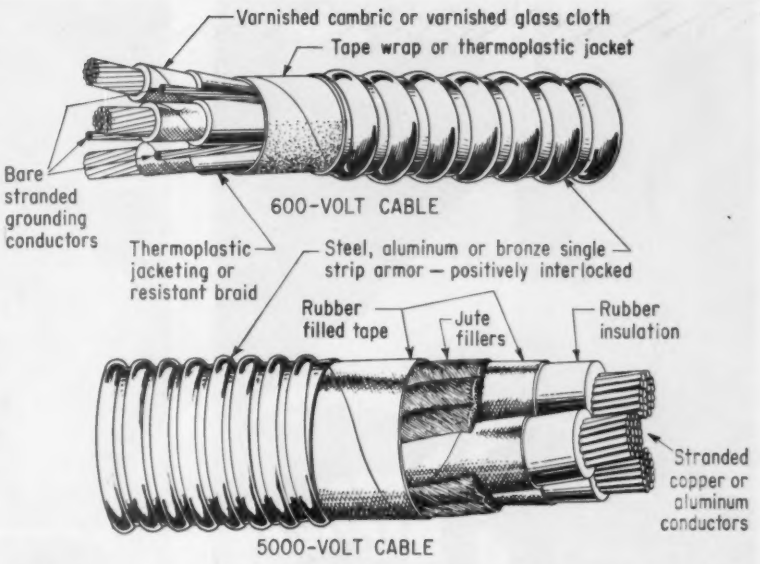
grounded systems. If a fault to ground finds a high resistance in the ground path, the value of current flow may not be high enough to operate the overcurrent device to clear the circuit. The current may not be of sufficient value to operate a time-delay fuse or CB before a person might make contact with equipment at voltage above ground. Or it may not be able to operate the device at all. In either case, a serious hazard could exist. Care must therefore be taken to design for an effective grounding path.

UL-labeled armored cable is familiarly used in all types of electrical systems for power and light branch circuits and feeders. It is also used for signal and control circuit work. It is particularly effective for running loudspeaker circuits in public address systems and other sound systems where the flexibility of the cable lends itself to ready installation on new construction or rewiring jobs and the armor provides much needed mechanical protection. Armored cable is also especially effective for wiring Class 2 control circuits—such as low-voltage relay switching circuits—where mechanical protection for the conductors and flexibility of installation are required.

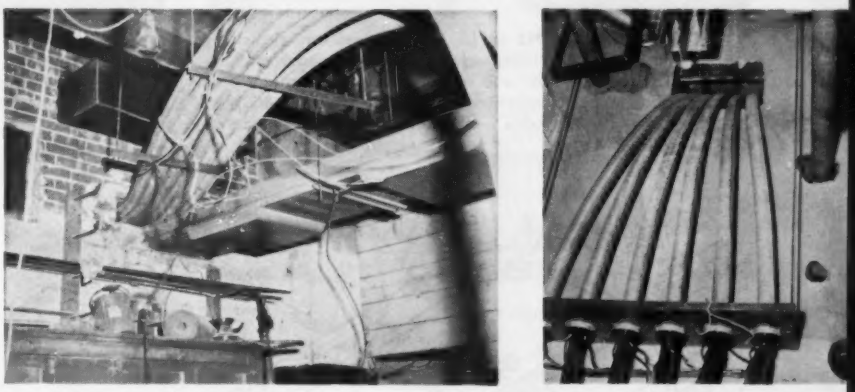
Code regulations on installations of armored cable basically are as follows:

1. UL-labeled armored cable may be used for—
   a. Exposed work in dry locations.
   b. Concealed work in dry locations.
   c. Underplaster extensions of branch circuits in fire-resistant buildings.
   d. Imbedded in plaster finish on brick or other masonry, except in damp or wet locations.
   e. Run or fished in the air voids of masonry block or tile walls where such walls are not exposed or subject to excessive moisture or dampness but not below grade line.

2. For use where the cable is exposed to weather or continuous moisture, for underground runs and embedded in masonry, concrete or fill in buildings in course of construction or where exposed to oil, gasoline or other deteriorating agents, the conductor assembly within the armor must be protected by a lead covering.


Varnished cambric or varnished glass cloth
Tape wrap or thermoplastic jacket
Bare stranded grounding conductors
600-VOLT CABLE
Thermoplastic jacketing or resistant braid
Steel, aluminum or bronze single strip armor — positively interlocked
Rubber filled tape
Jute fillers
Rubber insulation
Stranded copper or aluminum conductors
5000-VOLT CABLE

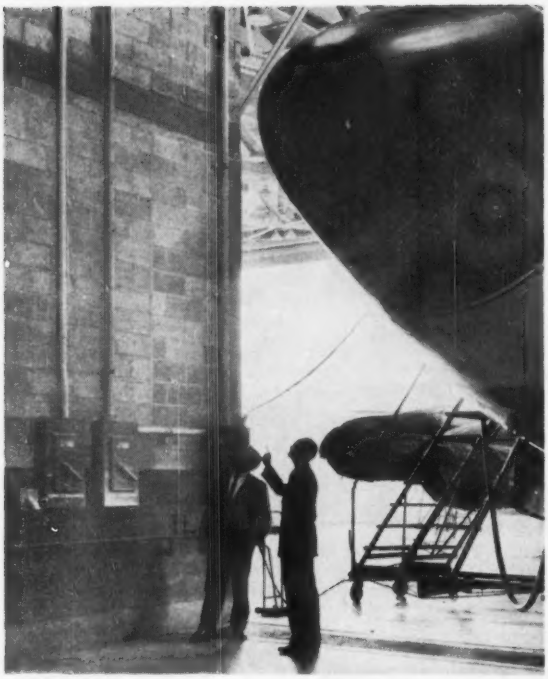
ASSEMBLY DETAILS of two typical constructions of interlocked armor cable. Many specific assemblies are available.

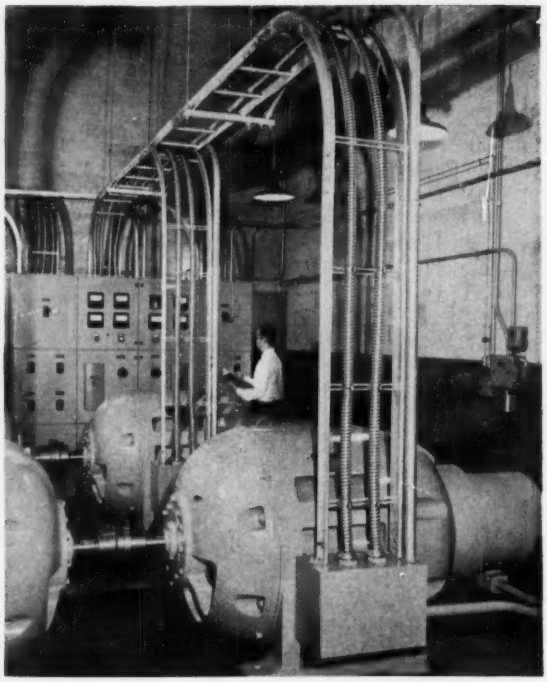


RENOVATED DISTRIBUTION is an effective application for interlocked armor cables when heavy-duty circuits must be carried through tight, congested spaces with many obstructions to straight runs. Conduit or busway simply cannot be used under such circumstances on many jobs. The flexibility of IA cables ideally suits them to the task. Here a multiple feeder of six 4-wire cables (six conductors per phase and six for the neutral) is brought into a building basement at left and run through heavily congested ceiling space to the location of a 3000-amp CB for a busway riser (at right).

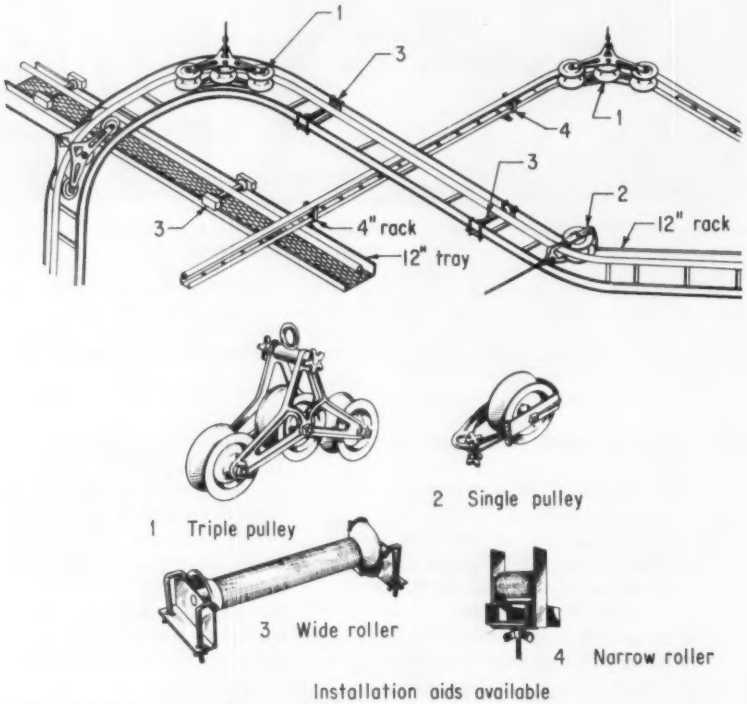
3. Armored cable must not be used—
   a. In theaters, except that it may be used if a theater has a capacity of less than 200 persons (determined in accordance with the NFPA Building Exits Code).
   b. In motion picture studios.
   c. In any hazardous location.
   d. Where exposed to corrosive fumes or vapors.
   e. On cranes or hoists, except where used to provide necessary flexibility in connections to motors and similar drive equipment.
   f. In storage battery rooms.
   g. In hoistways or on elevators, except that it may be used: between risers and limit switches, interlocks, operating buttons and similar devices; and on cars, where in short runs, free from oil and securely fastened in place.

4. Armored cable must be secured by approved staples, straps or similar fittings—designed and installed so they do not injure the cable. Cable must be secured at





TYPICAL APPLICATIONS of IA cable in modern electrical systems include a multi-conductor receptacle branch circuit through CB unit (at left) and aluminum armored cables for high frequency power distribution from generators to the switchboard and to the loads. In this latter case non-magnetic character of armor reduced circuit reactance making possible acceptable voltage drop and regulation. Also, in this latter case, the supporting ladder racks for the cable and the entire switchboard housing are made of aluminum for the same reason.



INSTALLATION TECHNIQUES for IA cable are shown here where various rollers and pulleys are used to pull the cable onto its supporting rack or tray. Numbers on rack and tray layout indicate the type of device used. Aluminum racks do not have to be painted and are highly corrosion resistant. Their non-magnetic character minimizes reactance. The conductivity provides a solid path to ground.

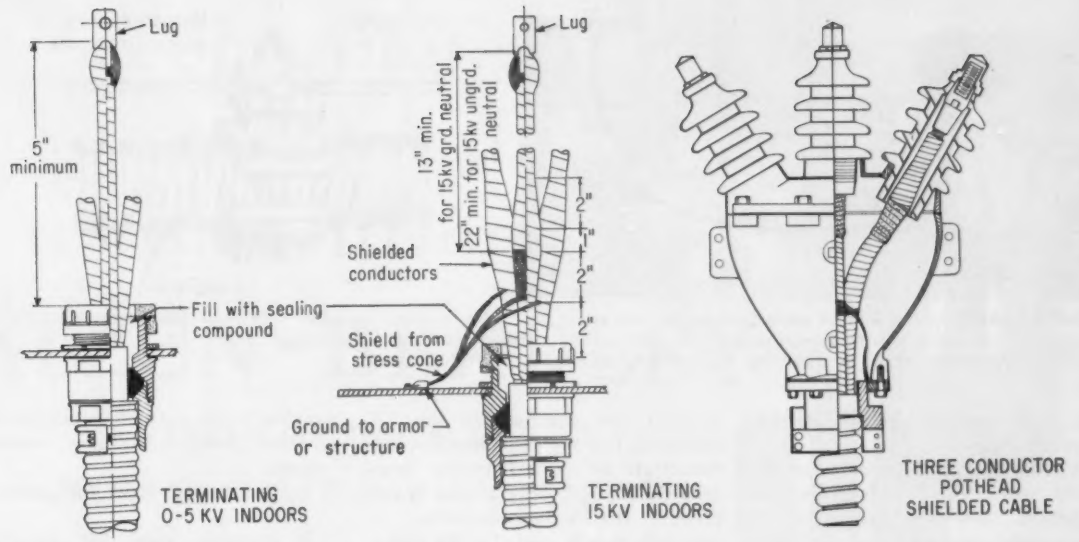
intervals not exceeding 4½ ft and within 12 in. of every outlet box or fitting—except where cable is fished and except lengths of not over 24 in. at terminals where flexibility is necessary.

5. At all points where armor terminates, a fitting must be used to protect wires from abrasion or design of the fitting or outlet box must provide such protection. In addition, an approved insulating bushing or its equivalent must be inserted between the armor and the conductors at each termination, except with lead-covered cable.

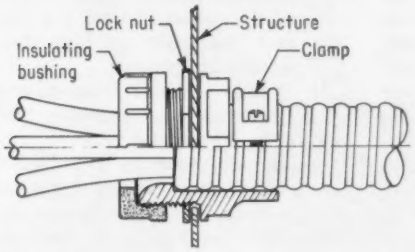
6. The permissible bend in any armored cable must not have a radius (of the inner edge of the bend) greater than five times the diameter of the cable.

Interlocked AC

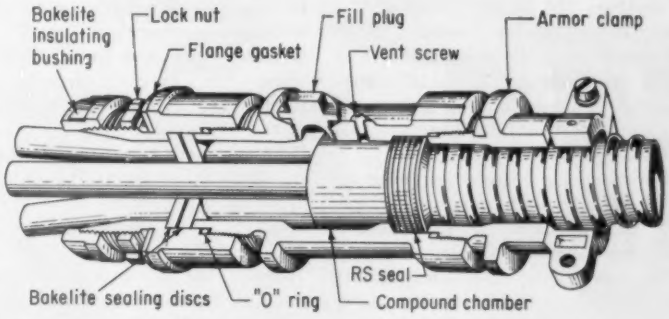
So called "interlocked armor cable" is basically a larger version of UL armored cable and is made in a wide variety of constructions for feeder and branch circuit applications up to 600 volts and in ratings for 5-kv and 15-kv circuits. The armor on such cables may be of steel, aluminum or bronze and is wrapped on with the same edge



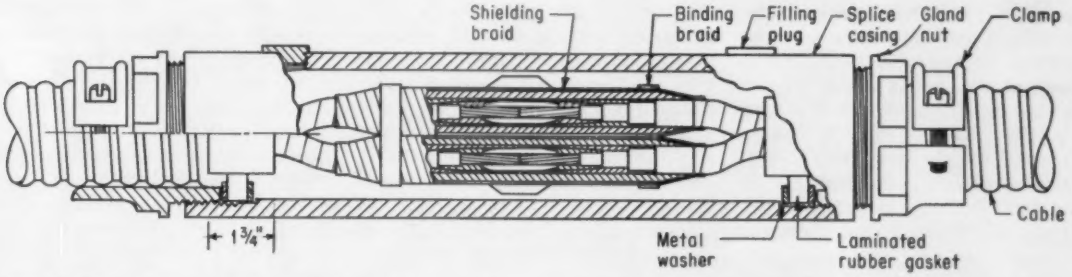
HIGH-VOLTAGE CONNECTORS (5 kv and 15 kv) are generally filled with sealing compound and individual conductors terminated as shown, depending upon whether the conductors are shielded or not. Or the IA cable may terminate in a pothead for positively sealed and insulated terminations indoors or outdoors.



600-VOLT TERMINATIONS for interlocked armor cable to switchgear or other enclosures in dry locations can be made with connectors, a locknut and a bushing in the typical basic assembly shown here. In damp locations, compound-filled or other protective terminations may be desired.



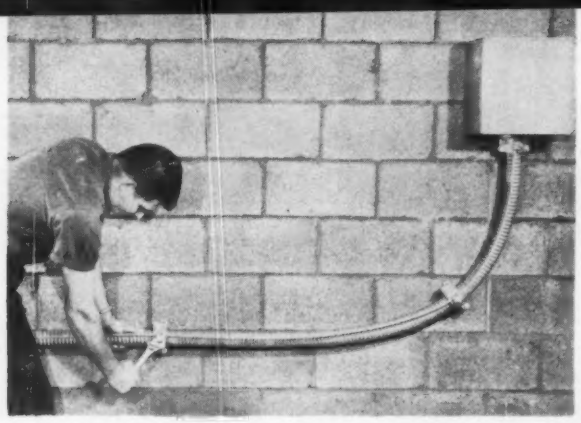
CONSTRUCTION DETAILS of a compound-filled terminal connector for IA cable which can be used in any position by pouring the compound before the connector is positioned.

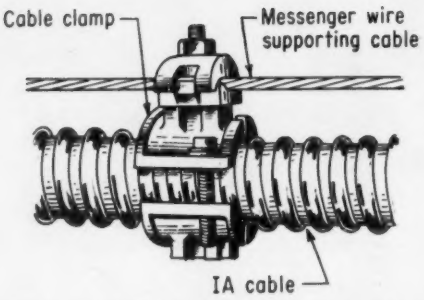


CABLES SPICES may be readily made with special splice enclosures equipped with end clamps for the cable armor. Types are available for 600-volt cables and high-voltage cables for use with or without compound.

interlocking as is used in UL-labeled armored cable. Various insulations are used on the conductors which make up the wiring assembly within the armor, to provide for particular job conditions of space, temperature and moisture. These cables, which are not made to any UL standard and are not UL labeled, are available with a complete line of fittings and accessories to provide systems of armored cable distribution.

The NE Code, in Sections 334-2 and 334-3, refers to Type ACV armored cable. This cable, which is not covered in the UL standards on armored cable, has varnished-cambric insulated conductors and is in the category of interlocked armor cable. The code specifically says the following about Type ACV, differentiating it from UL-labeled cable:





CABLE CLAMP for use with IA cable provides for messenger support of the cable in a horizontal position (at left) or vertical or horizontal support by mounting the clamp to a wall or other surface (at right) with an external grounding conductor mounted to the clamps.

1. ACV need not have an internal bonding strip.

2. ACV may be used *only for exposed work in dry locations in buildings used for industrial or commercial purposes* and shall not be smaller in size than No. 4, except where approved for use in systems rated above 600 volts. Use in high-voltage systems is set down in sections 710-3 and 710-32 of the code, listing metal armored cable as an acceptable wiring method when the cable is "suitable" (presumably by design and testing of the manufacturer) for the "use and purpose."

Because the code does refer to Type ACV armored cable in Article 334, it is reasonable to conclude that all provisions for armored cable apply as well to interlocked armor cable as to UL-labeled cable. That Article 334 of the code does intend to cover interlocked armor cable is further suggested by the references to Sections 710-3 and 710-32, which cover circuits above 600 volts—for which applications the only type of armored cable available is the so-called "interlocked armor cable." And inasmuch as ACV *is* interlocked armor cable, the conclusion may be drawn that other interlocked armor cables must also satisfy the same set of basic installation requirements.

It should be noted that the code refers only to "armored cable" and rules on three types of armored cable—1. Type AC or ACT, 2. Type ACV, and 3. Type ACL. The first category, AC or ACT, involves cables made to the UL standard. This category should also include type ACH (RH wires), since that type is in the UL standard. The second category, ACV, covers only one of the constructions of "interlocked armor cable." The third category covers cables which may or may not conform to the UL standard. But the code does not differentiate by name between "armored cable" and "interlocked armor cable." Distinction according to nomenclature is made by the manufacturers in their literature and advertising. And industry personnel —engineers and contractors—use the terms "armored cable" and "interlocked armor cable" generally to distinguish between small size, 600-volt cable and the circular mil sizes for larger circuits—even though there is an overlap in sizes of the two types.

Interlocked armor cable for use in 600-volt systems is generally made in sizes from No. 12 up to 1000 MCM, in assemblies of 2, 3 or 4 insulated conductors. Typical insulations for the individual conductors include: varnished-cambric with a braid jacket; rubber with jacketing of braid, tape, neoprene or thermoplastic; thermoplastic (polyvinyl chloride); impregnated asbestos and varnished cambric with asbestos or glass cloth braid; varnished glass cloth with thermoplastic jacket; and paper-insulation with lead jacket. Interlocked armor cables for systems rated over 600 volts are made in many standard and special constructions, with shielded and non-shielded conductors. Insulations and jackets include the above described in various forms, rated for 5,000 volts and 15,000 volts—for grounded and ungrounded circuits.

Interlocked armor cables are available with lead or thermoplastic jacketing over the cable assembly, under the armor, to provide protection against moisture, water, oils, chemicals, etc. Protective plastic jacketing may also be applied over the armor to resist attacks from corrosive atmospheres. And varied coloring of such outer jackets may provide for circuit identification in an installation. Available armors include:

A. Galvanized steel for general use.
B. Stainless steel for superior corrosion resistance and high strength.
C. Aluminum for corrosion resistance and/or light weight of the armor and for low circuit reactance on high frequency ac systems.
D. Bronze where conditions (such as non-magnetic enclosure) require.

Conductors used in interlocked armor cable may be either copper or aluminum. Size-for-size, copper conductors have higher current-carrying capacities than aluminum conductors and many times will give a smaller overall cable assembly diameter than aluminum conductors of the same current rating. This small differential in size is generally not significant. However, the weight differential between a cable with copper conductors and one with aluminum conductors may be a very significant factor.

IA cable systems provide a very flexible layout for industrial and commercial jobs where rerouting of feeders might be necessary as loads change. And, too, continuous current ratings of IA cable conductors, based on allowable temperature rise in free air, are higher than for equivalent sizes of conductors for use in conduit. Still another advantage lies in the close and tight assembly of the conductors in IA cable which provides better mutual cancellation of magnetic fields, reducing voltage drop. In evaluating alternative systems, care must be taken to distinguish between NE Code current ratings and ratings assigned by the IPCEA (Insulated Power Cable Engineers Assn.).

A complete new "family" of motor starters by

ALLEN-BRADLEY

producers of
"Quality" Motor Control

SIZE 00
Form 2

SIZE 0
Form 2

SIZE 1
Form 3

SIZE 2
Form 2P

SIZE 3
Form 1

SIZE 4
Form 3P

SIZE 5
Form 2

Note the "family" likeness and aristocratic appearance of all enclosures.

Greatest advance in motor

PLUS VALUES OF THESE NEW STARTERS

- smaller size
- greater interrupting capacity
- even more millions of trouble free operations
- more wiring room
- elegant styling
- A-B "quality" throughout

Thirty years of experience have gone into the design of this new Allen-Bradley line of motor starters. While retaining the principle of the simple solenoid design—with only ONE moving part—everything about these Bulletin 709 starters is **new**.

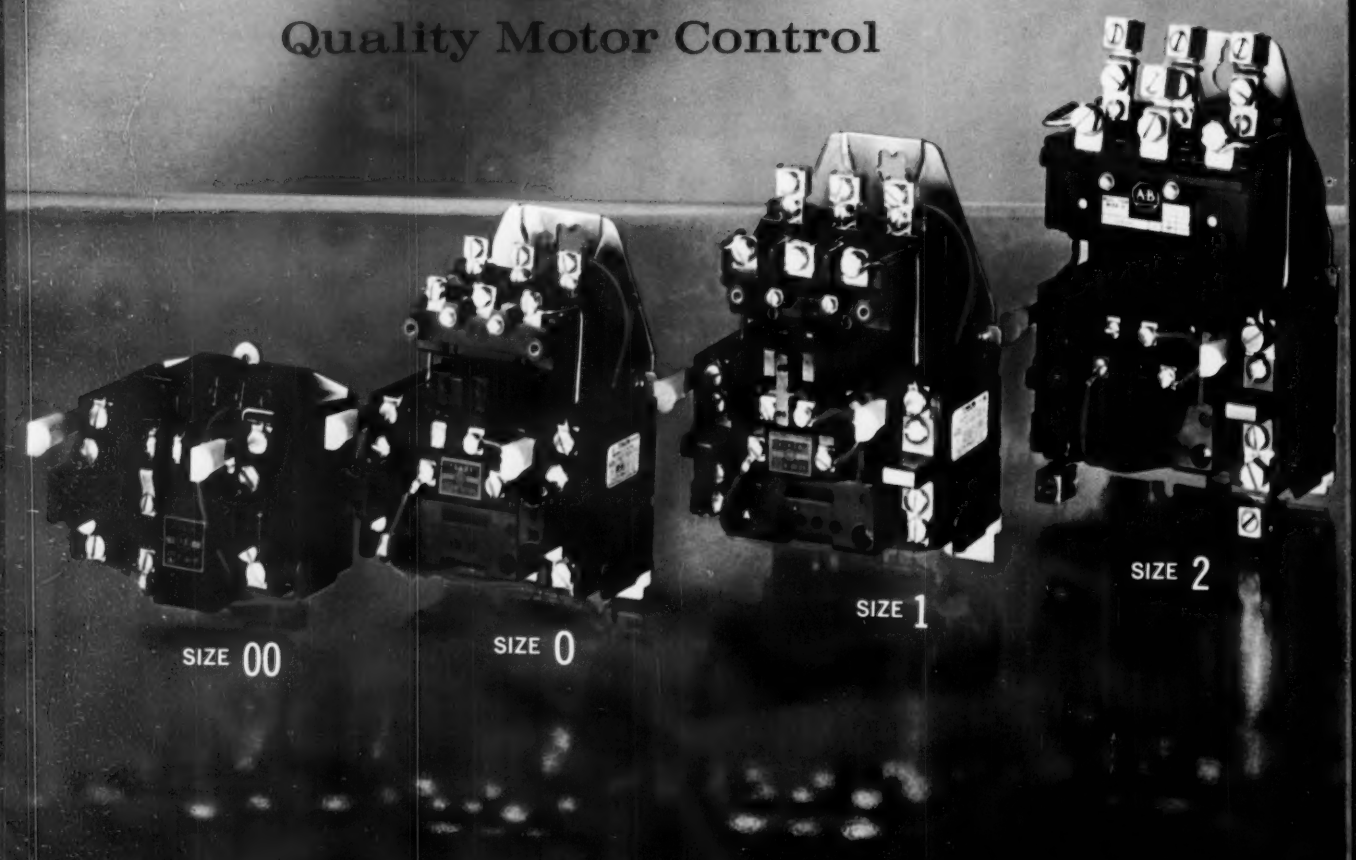
They're small—especially in the higher ratings. Yet, size for size, all tests have proved that they will outlast any starter now on the market —many times.

The **new**, patented, high-efficiency magnet—remarkably powerful for its weight and size—is cushioned to reduce shock and wear. The **new** coil is encapsulated for mechanical protection, and cannot be damaged by any corrosive atmosphere in which it may be used. The **new** precision hot molded arc hood confines the arc and increases the interrupting capacity.

ALLEN-BRADLEY

A-B QUALITY

Bulletin 709
Quality Motor Control



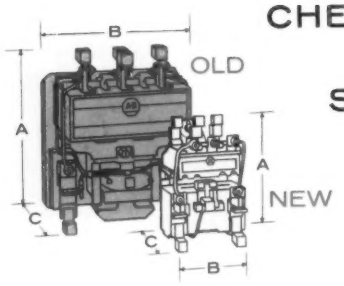
control...in 30 years!

New weld-resistant, cadmium oxide silver contacts close and seat firmly, eliminating the sliding motion that causes wear. The overload relays are also **new** and are not only completely *trip-free* but also *tamperproof*. Of course, they were designed to use the **old** Bulletin 709 heating elements you have in stock.

Brooks Stevens is responsible for the smart cabinet design—a distinct sales asset on any type of installation. Better write today for more information on this *revolutionary* **new** line of Allen-Bradley Bulletin 709 *quality* motor starters.

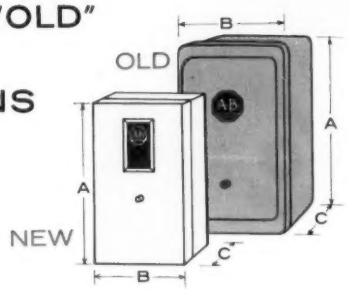
THESE NEW BULLETIN 709 ACROSS-THE-LINE SOLENOID STARTERS ASSURE YOU SUPERIOR PERFORMANCE IN YOUR TOUGHEST MOTOR CONTROL APPLICATIONS.

Note, also, the "family" likeness of all open type starters. Imagine the beautiful "special panel" engineering that can be done with this A-B family of starters, contactors, and relays.



CHECK THE "NEW" WITH THE "OLD" BULLETIN 709 SPACE-SAVING DIMENSIONS

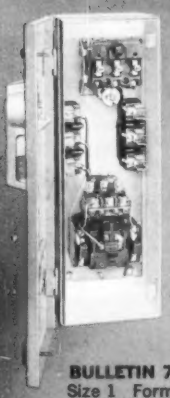
The wiring room in the new enclosure will delight the electrician.



TOTAL OVER-ALL DIMENSIONS

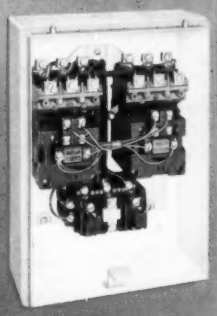
Starter Size	OPEN TYPE STARTERS						NEMA 1 ENCLOSURES					
	NEW			OLD			NEW			OLD		
	Height A	Width B	Depth C	Height A	Width B	Depth C	Height A	Width B	Depth C	Height A	Width B	Depth C
00	3 5/8	3 7/8	3 9/16	—	—	—	7 5/8	4 7/8	4 1/4	—	—	—
0	5 7/8	4 1/16	3 1 1/16	5 5/8	4 3/4	3 1/4	9 1/8	6 5/16	4 3/8	7 7/8	5 5/8	4 1/4
1	6 5/8	4 1/2	3 1 1/16	5 7/8	5	3 1/4	10	6 13/16	4 3/8	8 13/16	6 3/8	4 1/4
2	7 3/4	4 5/8	3 1 1/16	10 1/16	5 3/4	4 7/32	12	7 5/8	4 3/8	14 1/2	9	5 7/16
3	10 1/4	6 1/4	5 7/16	12 5/8	7 1/4	5 7/16	16 5/8	10 3/8	7	19 1/2	11 3/8	6 1 1/16
4	11 7/16	7 5/16	6 1/4	16 1/4	12 3/4	6 1 5/16	22	11 5/8	8	26 9/16	14 3/16	7 1 1/16
5	14 1 3/16	9	6 1/2	20	16 1/8	8 3/4	32 3/16	17 3/16	9 7/8	41 1/2	19 9/16	13 9/16

Also...other across-the-line starters in the NEW A-B design!

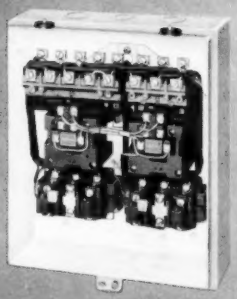


BULLETIN 712
Size 1 Form 2F
Fused Disconnect

BULLETIN 713
Size 2 Style RT
Circuit Breaker



BULLETIN 705
Size 1 Style RT
With Overload Relays



BULLETIN 715
Size 1 Two Speed
Consequent Pole

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Quality Motor Control

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wisconsin

A-B QUALITY

9-61-RM

High Footcandle Levels In Manufacturing Plant

Practicing what they preach, a lighting equipment manufacturer achieves IES recommended footcandle levels in various plant areas.

MODERN, high-level lighting is an outstanding feature in a manufacturing plant producing lighting equipment. The lighting in the plant of Lighting Dynamics Inc., West Coast subsidiary of John C. Virden Company, effectively helps sell the luminaires manufactured within the plant. Installed throughout the plant and offices are fixtures carefully selected for their varying functions. As such, they not only provide the desired quantity and quality of illumination, but also serve to display the efficiency and appearance of many different types of luminaires.

All installations meet the lighting standards established by the Interflectance Method of the Illuminating Engineering Society. Visitors to the plant not only can view the firm's lighting fixtures in actual use but can, in addition, see advanced lighting standards applied and the obvious benefits gained. In the plant proper, a level of 140 footcandles is maintained. In more critical operational areas, such as sheet metal production, levels are in excess of 175 footcandles. In less critical areas, such as shipping and stocking, 108 footcandles are provided. To arrive at these desired levels most efficiently and comfortably, uplight (slotted) fixtures are used throughout the plant. Ceilings are painted flat white and uplight completely eliminates all dark areas.

In the offices, fixtures manufac-

175 FOOTCANDLES of lighting provide for the visual acuity required in the sheet metal production area.

200 FOOTCANDLES at desk top level illuminate the office area used for inside sales and material control.

150 FOOTCANDLES at desk top level are provided from dimmer-controlled luminaires in the accounting area.

VARIETY OF LUMINAIRES for commercial and residential applications are on display and provide light in cafeteria.

The *right* extension cord is essential for safe, dependable operation of on-the-job equipment and temporary lighting . . . the *right* size to carry the load, the *right* length to supply the power without voltage drop. That's why there's a Royal heavy-duty POWR-KORD to fit *every* job. Available in one quality (the very best) . . . two types (rubber and vinyl) . . . three colors (red, black, yellow) . . . four wire sizes (12, 14, 16, 18) . . . and over five handy cord lengths (10 to 100 ft.). See your wholesaler. He has the facts — and Royal POWR-KORDS in stock, ready for your work.

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ROYAL ELECTRIC CORPORATION
PAWTUCKET, RHODE ISLAND
In Canada:
Royal Electric Company (Quebec) Ltd., Pointe Claire, Quebec

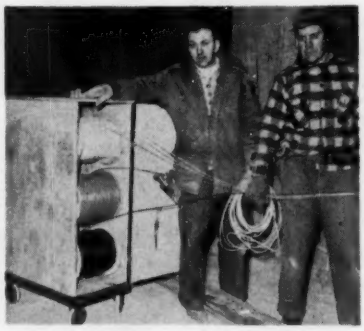
tured by the concern for offices, lobbies, corridors, retail establishments, and other nonmanufacturing areas are installed. Lighting in two of the larger general office areas is dimmer-switch controlled, which permits demonstrating levels of illumination ranging from 0-200 footcandles. Finally, in the modern cafeteria, the fixtures used are those designed for commercial and residential applications.

Still another interesting sight in the plant is an up-to-the-minute Photometric Lab. Here, luminaire designs are tested and proved prior to their introduction. Performance curves and IBM Tabulated Coefficients of Utilization are also constructed from the information developed.

Mobile Wire Cabinet For Payout, Storage

A number of electrical contractors are taking advantage of the availability of No. 12 and No. 14 building wire in 2,500-ft reels, particularly on projects involving extensive branch-circuit work. Since one reel replaces five standing 500-ft coils, job material handling is reduced and fewer returns to the field stock room for replacements are needed.

Supplementing these economies are a variety of efficient wire payout techniques. Generally, individual contractors tailor their methods to specific job requirements. Some develop universal methods that can be used on practically any type of project. A combination wire payout and storage unit used by Gilbert-Hodgman, Inc., Chicago electrical contracting firm, falls in this category.



MOBILE WIRE CABINET doubles as payout device and, with door locked, storage unit on large apartment house project. Unit was designed and built by Gilbert-Hodgman, Inc., job foreman Robert Opfer (right).

KNOW YOUR SYMBOLS

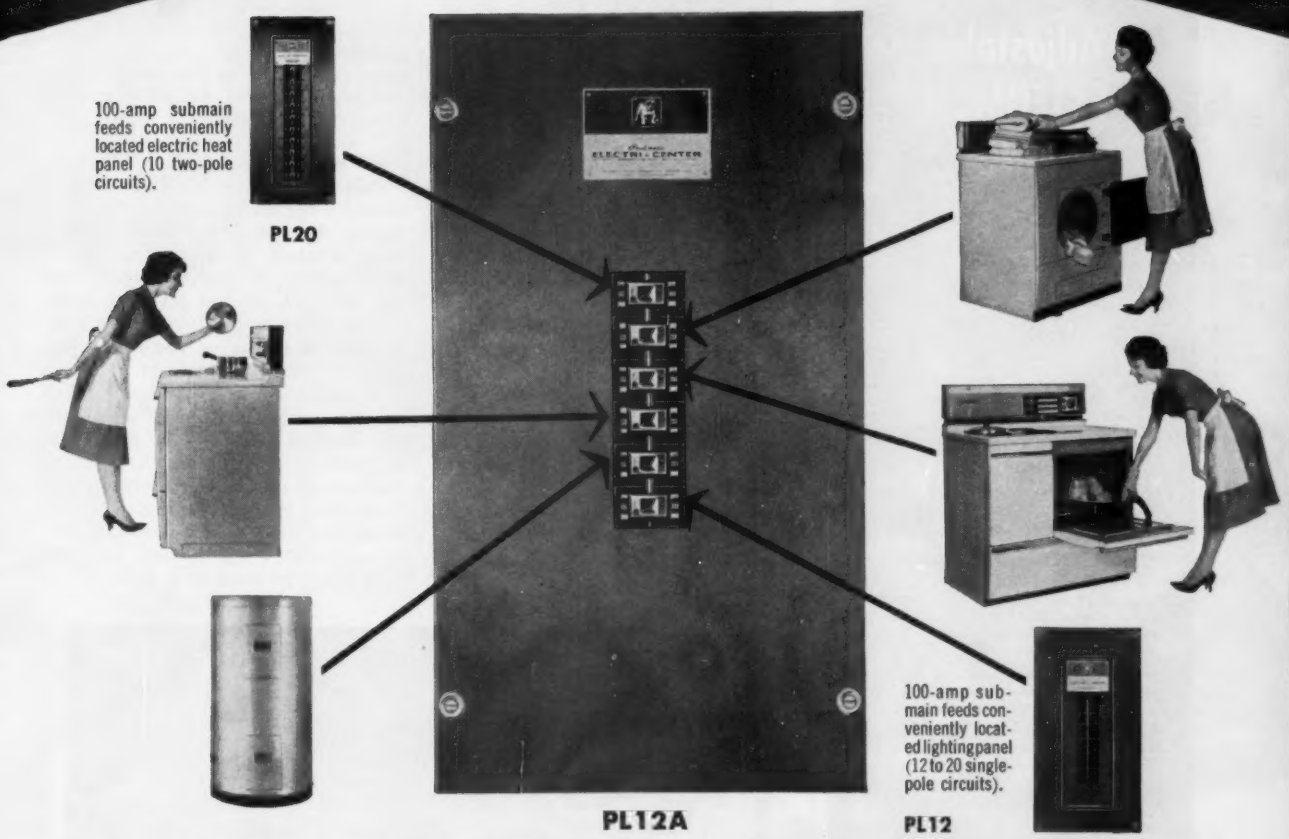
This symbol stands for circuit breaker

This symbol stands for QUALITY

BULLDOG'S 200-AMP SERVICE DISTRIBUTION PANEL—

"Power-packed" for all-electric homes!

Here's Electri-Center circuit flexibility aplenty for heating; lighting, appliances...



100-amp submain feeds conveniently located electric heat panel (10 two-pole circuits).

PL20

100-amp submain feeds conveniently located lighting panel (12 to 20 single-pole circuits).

PL12

PL12A

Originated by BullDog expressly for service distribution in all-electric homes, the Pushmatic® 200-amp PL12A Electri-Center® provides any combination of circuits up to 24 poles . . . and allows location of subpanels for customer convenience—and *wiring convenience!* Other 100- and 200-amp Electri-Center panels provide a wide choice that meets all other residential requirements.

Pushmatic circuit breakers protect two ways! In Pushmatic breakers from 15 to 50 amps, a built-in time-delay prevents nuisance tripping from harmless, normal current inrush, but assures positive protection against dangerous overloads. In every Pushmatic, a magnetic coil trips immediately, *without* delay, if a short circuit occurs. By combining these two safety systems, Pushmatic breakers assure dependable protection under all residential load conditions.

For details write for your "Pushmatic Pocket Guide"—it's free!

BullDog Electric Products Division, I-T-E Circuit Breaker Company, Box 177, Detroit 32, Mich. In Canada: 80 Clayson Rd., Toronto, Ont. Export Division: 13 East 40th St., New York 16, N.Y.

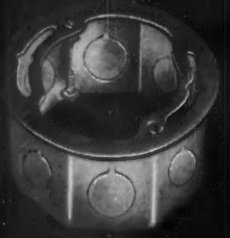
I-T-E CIRCUIT BREAKER COMPANY

BULLDOG ELECTRIC PRODUCTS DIVISION

NEW
JOB TESTED
O.K.
ECONOMICAL

Arrow Conduit

Adjustable EXTENSION RING



- Saves time . . . no need to bend conduit.
- Saves cost of special devices.

Designed for easy attachment to already installed ceiling boxes in older buildings — or where building plans have been changed.

Special slots allow extension ring to be turned in either direction to line up knockouts with incoming conduit.

Will fit all standard 4" octagon boxes and concrete rings.

Standard depths: 1½" & 2".

Supplied with ½" & ¾" knockouts.

Samples and specification sheets on request.

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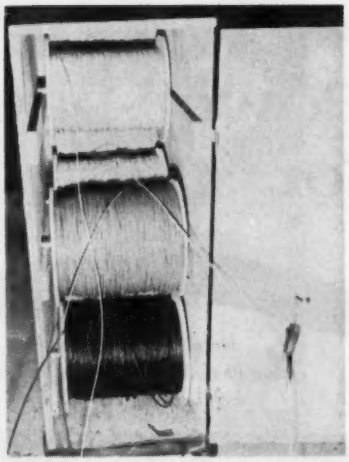
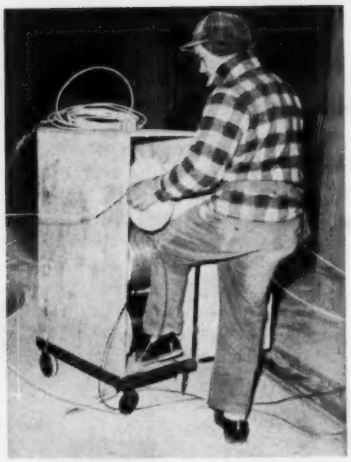


NOTCHED RAILS inside cabinet seat spindles of six 2,500-ft reels of branch circuit wire. Wire is color-coded according to circuit requirements.



LOADING and unloading reel cabinet is a simple chore. Cabinet lifts off angle-iron base which then can be used as a dolly to move other equipment.

The device, designed and built by G-H job foreman, Robert Opfer, is a simple mobile cabinet. It can be used for payout and has a hinged door that can be locked, like a tool box, at the end of the day for on-the-spot storage. The cabinet holds six 2,500-ft reels of wire color-coded as required; can be easily moved from place to place through narrow corridors and doors; simplifies branch-circuit wire installation after or before plastering is done. Some local inspection authorities permit wire pulling before plastering if approved, snap-in metal outlet box covers (and locators) are used.

The wire cabinet is of ¾-in. plywood construction with the following approximate inside dimensions: height—41 in.; width—15 in.; depth—26½ in. Three tiers of plywood notched "rails" on the inside seat conduit spindles supporting the six reels. A hinged plywood door on the front, with sturdy hasp and padlock, is kept open for wire payout and locked for storage.

Mobility is provided by a 2-in. by 2-in. angle-iron base in which the cabinet rests. This frame is supported by four 5-in. rubber-tire casters—two stationary type in the back; two swivel type in the front. When the wire cabinet is not in use, it can be lifted off the base and the frame can be used as a dolly.

CORROSION IN A SALT MINE can be a tough problem for specifiers of electrical equipment. And, when that mine is 2000-ft deep and located near the shore of a lake (as is the case with a mine just developed by Morton Salt near Fairport Harbor, Ohio), the problem is compounded through the possible presence of moisture. In this instance, approximately five miles of bare aluminum conduit is installed for power distribution and shows no signs of deterioration.

There's short-circuit safety in numbers

(You can choose the right fuse size and rating)

There are more than 200 different sizes and ratings for high-voltage non-expulsion current-limiting fuses—and General Electric makes them all. It's your assurance you can choose a fuse exactly right for your application.

Easy to co-ordinate with relays, circuit breakers, and other protective devices, these fuses provide dependable short-circuit protection for individual motors, capacitors, power transformers, load centers, potential transformers, and feeder circuits.

Ratings range all the way from 600 to 34,500 volts in a wide range of ampere ratings. Indoor and outdoor types are available.

All sizes are in stock. Emergency orders can be filled fast.

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NEARBY SERVICE on Black & Decker tools.

Black & Decker maintains 50 factory service branches plus authorized service stations to give your B&D tools the attention mechanical products need periodically. Keep your B&D tools in top condition, on the job all the time.

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SWIFTY SERVICE says be sure to ask about:

FREE TOOL INSPECTION no cost, no obligation.

STANDARD B&D GUARANTEE after completion of all recommended repair work.

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Reversible-Wiring Safety Switches Cut Costs

Wiring line and load conductors to enclosed safety-switch terminals can be a problem, particularly where line conductors feed from below the switch. The condition often occurs where underground services run to a building and terminate in a main switch, and also where safety switches are installed above an auxiliary gutter. In the past, these problems were solved by: 1) running line conductors from the bottom of the switch to the line terminals at the top; 2) using special upside-down boxes; or 3) running the supply conduit to one side of the switch and installing pull boxes or conduit fittings. All three of these methods add more cost to the job.

Knowing this, John Kaiser, owner of the Shirley Electric Corp., Patchogue, L. I., N. Y., found a practical application for General Electric's reversible-wiring safety switches on one of his commercial jobs. Specifications for this particular job called for running a 4-wire, 3-phase underground service to a 400-amp main fused switch. Then through a series of gutters, two 100-amp and two 200-amp feeder safety switches would be tapped from main feeder conductors contained in auxiliary gutters below.

After investigating the features of the reversible-wiring safety switches, Kaiser found that these switches would save considerable expense; and at the same time they would prevent wire abrasion, often caused by looping cables from bottom to top and vice versa.

With the reversible-wiring safety

JOHN KAISER, owner of Shirley Electric Corp., Patchogue, L. I., N. Y., operates handle of 100-amp, 4PSN, reversible-wiring safety switch. Two 100-amp and one 200-amp switches are fed from mains in auxiliary gutter below. Connections are made to terminals at bottom of each switch. Load conductors feed off top terminals of switches.

It took contractors a short two and a half years to catch up with the output of the first CIRTUBE EMT mill. Now, a second mill, just recently put into operation, helps meet expanding contractor needs.

Reason for CIRTUBE's quick success? Consistent high quality—from tube to tube, bundle to bundle, month to month—the same easy fishing and bendability, the same good looks. That ...and fast, friendly Circle service.

If you're not yet a CIRTUBE EMT user, be sure to try it on your next job. You...and your men ...will like working with it.

CIRCLE WIRE & CABLE CORP.

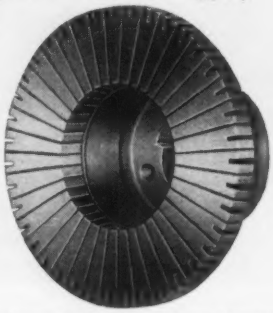
SUBSIDIARY OF **CERRO CORPORATION**

PLANTS: Maspeth and Hicksville, N. Y. **SALES OFFICES & WAREHOUSES:** In all principal cities.
Rubber Covered Wires & Cables • Varnished Cambric Cables • Plastic Insulated Cables • Neoprene Sheathed Cables • "CIRTUBE" EMT

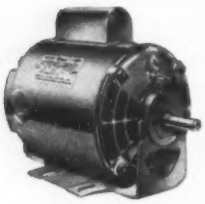
CIRTUBE EMT *Ask for it!*

USE WAGNER® STANDARD ARMATURES FOR MORE PROFITABLE, FASTER REPAIR JOBS

Rewinding small motor armatures takes valuable time and returns little profit. When you use Wagner® Standard Armatures for replacement, you can give your customers faster service, and keep your equipment free for bigger, more profitable jobs. And there's no guesswork to finding the right armature; Wagner K and M "spec" lists, when used with the label on the package, make certain you get the right armature every time.



When you do rewind armatures, use genuine Wagner Replacement Commutators. Exactingly built, they withstand great centrifugal force . . . last for years.



IF THE MOTOR ISN'T WORTH REPAIRING SELL A NEW WAGNER® MOTOR

Today, more than ever, there are times when it just doesn't pay to repair an old motor . . . times when both you and your customers lose unless the motor is replaced.

By replacing worn-out motors with new Wagner motors you remove any doubt about making a profit on repairing a badly worn motor, and save time for other repair work. Best of all, you make full profit on every Wagner motor sale, plus giving your customers over-the-counter service. Contact your Wagner distributor now . . . get the motors and point-of-sale merchandising aids that will help you cash in on replacement motor sales.

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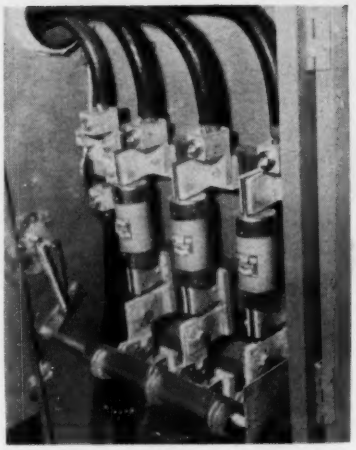
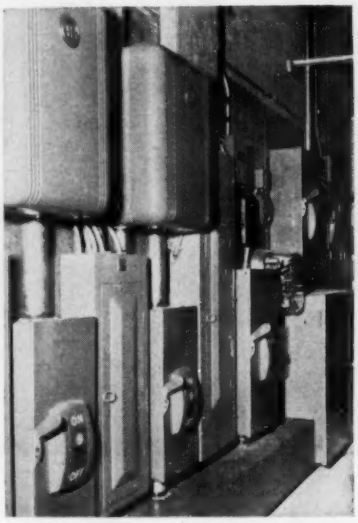
OVER 850 AUTHORIZED SERVICE STATIONS OR PARTS DISTRIBUTORS

MOTORS • BEARINGS • STANDARD ROTORS • BRUSHES • CAPACITORS • COMMUTATORS



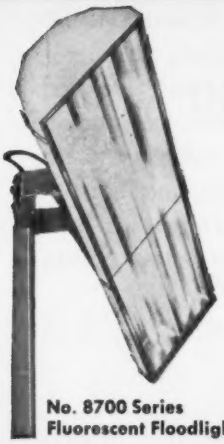
LOAD CONDUCTORS, 3 500 MCM and one 4/0, run from top terminals of a 400-amp, 4PSN reversible-wiring safety switch. Notice abundance of free space for conductors, which prevents abrasion that often occurs in "loop" systems. Service enters bottom of switch enclosure, terminating in lower line terminals.



VIEW SHOWS four reversible-wiring safety switches (two 100-amp and two 200-amp) fed from supply mains below to lower switch terminals. Such an arrangement cuts lengths of wire required to each switch plus providing extra free space in enclosures.

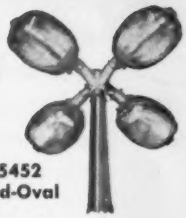
switches, ON-OFF indication remains unchanged. And the switches can be obtained with line lugs factory-installed at bottom or can be readily changed in the field.

The switches shown in the accompanying photos are all fed from below to bottom LINE terminals in each switch. Load conductors feed out the top of each switch. Kaiser figured that this saved about 10 to 15 ft of wire at each 4 PSN safety switch.



No. 8700 Series
Fluorescent Floodlight

No. 5442
Ultra-Lite



No. 5452
Quad-Oval

No. 7400 Series Floodlight

Widest line of fixtures lets you light malls and parking lots the one best way for each job

There's one *best* way to solve each application problem in lighting parking lots, shopping malls, or other outdoor areas. Planned with Revere Fixtures, you can do the job at hand without compromising on the type of equipment required to do it the best way.

Revere offers the widest line of outdoor lighting equipment of any manufacturer. You can choose exactly the components you need — hinged or rigid poles . . . mercury, incandescent or fluorescent luminaires—floodlights, fixtures and fittings. All Revere components are matched for easy installation, strength and balance, peak lighting efficiency and attractive appearance, too.

Revere's outdoor lighting catalog makes it easy for you to select equipment to solve more outdoor lighting problems of any type with fixtures that are best for the job. Write for your copy. Consult your Revere wholesaler about your next outdoor lighting job.

Revere ELECTRIC MFG. CO.

OUTDOOR LIGHTING

Revere Electric Mfg. Co. • 7420 Lehigh Avenue • Chicago 48, Illinois (In suburban Niles)
Long Distance Phone: NIles 7-6060 • Chicago Phone: SPring 4-1200 • Telegrams: WUX Niles
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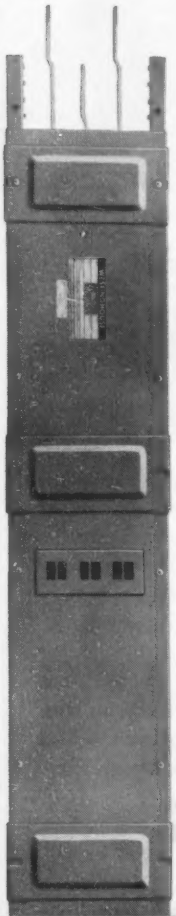
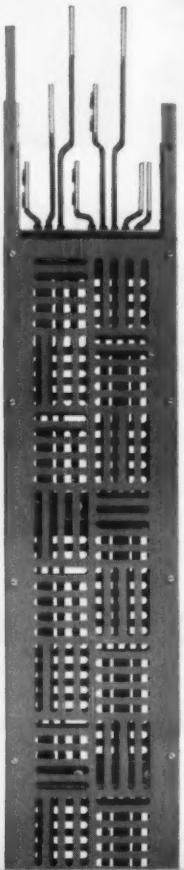
8 types of Westinghouse bus duct— WHY?

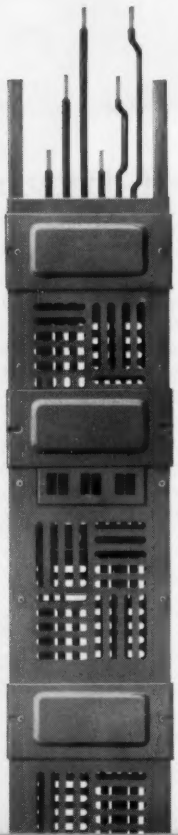
PLUG-IN . . . For industrial or commercial applications . . . 225- through 1000-ampere ratings. Plug-in outlets every 12 in. along run. Good for meeting changing requirements in industrial plants.



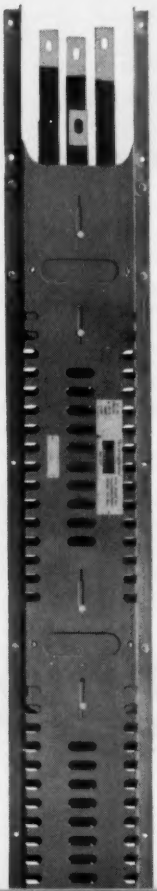
LOW IMPEDANCE . . . Maximum efficiency for long feeder runs . . . 600- through 5000-ampere ratings. Indoor or outdoor applications. A wide variety of special fittings makes this bus duct most flexible to meet special requirements.



PLUG-IN LOW IMPEDANCE . . . Combines the high efficiency of low impedance design plus the convenience of plug-in receptacles. Ratings 600 through 4000 amperes. Accepts standard 3-pole plug-in devices, interchangeable with conventional plug-in duct.



LIFE-LINE . . . A plug-in bus duct with the ultimate in safety features. The plug-in unit can be completely installed and wired before contact is actually made with the bus bars. Ratings 225 through 4000 amps.



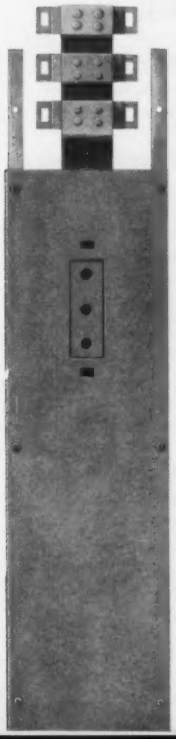
Simply because no **one** type will properly meet all duct applications. When the factors of voltage drop, frequency, over-all cost, capacity and plug-in features are weighed, it takes many types to do the job properly. That's why Westinghouse makes 8 specialized types of duct.

To the consulting engineer, this means the opportunity for optimum design; to the contractor it means fast installation; to the plant engineer it means power savings and low maintenance.

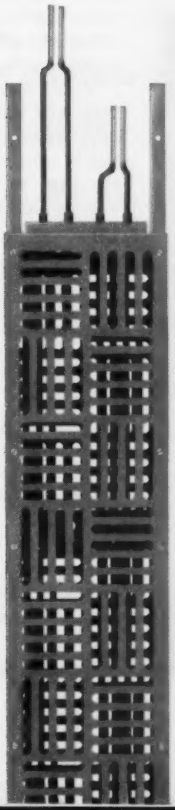
Want complete information on how these 8 types of Westinghouse bus duct can provide a long and useful life for a new building or a new lease on life for an old one? Contact your Westinghouse representative or write: Westinghouse Electric Corporation, Standard Control Division, Beaver, Pa. J-30322

Westinghouse

HIGH-FREQUENCY... Most efficient of **all** power distribution systems for high-frequency application—400 cycles and above. Voltage drop of less than 1 volt per 100 ft at full load. Has plug-in convenience for easy power take-off. Typical applications include aircraft or electronic manufacturing, induction heating and many others.

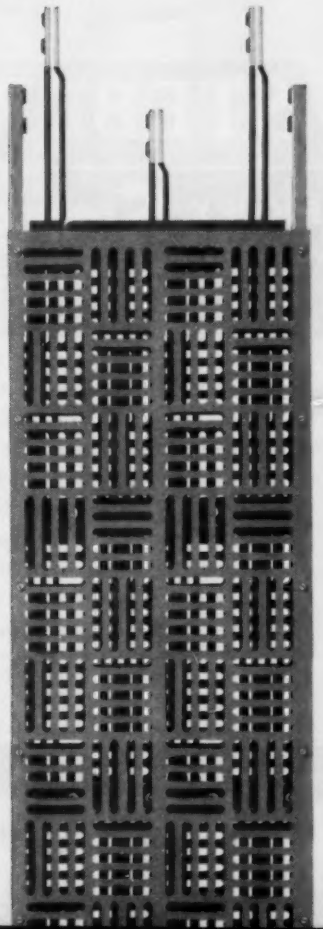


D-C (Electric Utility) . . Specially for the distribution of direct current in power plants or factories. Available in ratings of 225 to 12,000 amperes. Uses include excitation service for turbine generators, telephone exchanges, battery charging and plating facilities.



100-AMP . . . A new low-capacity, low-cost busway system designed for low current applications with all of the inherent advantages of bus duct. Has plug-in convenience, complete salvability, low installed cost. Fast installation possible because of snap-together joint and completely captivated hardware.

CURRENT LIMITING . . . A bus duct for use feeding from networks, designed specifically to limit the fault current to a value that conventional circuit protective devices can safely interrupt. Ratings 1000 to 4000 amps. Ideal for entrance runs. It also can be used in conjunction with other types of duct.



Floodlights have spun aluminum reflector with ANODAL finish. Cast aluminum socket housing has built-in cooling fins, integral wiring compartment and watertight connector. Silicone gasketing at critical points. All hardware except yoke and mounting bracket is non-ferrous or stainless steel.

STEBER

MERCURY VAPOR **Spreadliters**

400-1000 WATTS

Color Corrected Lamps—Ribbed or Clear Heat-Resistant Lens

- Uniform Distribution: No Hot Spots
- Full 18" Parabolic Reflector: No Trapped Light
- Fin Cooled: For Greater Efficiency
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- Versatile: Can Be Used Anywhere
- Listed by Underwriters' Laboratories

Sold NON-EXCLUSIVELY Through Recognized Steber Distributors

Write for Spreadliter Bulletin with Photometric Data and Description of Optional Mounting Arrangements.

STEBER DIVISION • THE PYLE-NATIONAL COMPANY

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MANUFACTURED IN CANADA BY
Pyle-National (Canada) Ltd. 23 Ingram Drive, Toronto 15, Ontario

ESTIMATING FORUM—XI

[FROM PAGE 89]

Column "B"—Acceptable

Before studying Column "B" figures in detail, let's look at the total time which is 80 minutes, or 1⅓ hours. Over the years, contractors have found that one hour represents a reasonable time allowance for the listed items—not including the "coffee break." Inclusion of two coffee breaks adds 20 minutes per day making the 80-minute total.

Changing Clothes: Differences of opinion exist regarding time allowance for changing clothes in the morning. Without going into the pros and cons, let's look again at the 80-minute total time. That is all a job can be expected to stand for such phases of incidental labor. At the current high wage rate there is a limit to how much an owner should pay men for "not working."

Selecting Tools and Getting on the Job: The tools referred to are the ordinary hand tools. Special allowances must be made for such large equipment as pipe benders, cable pullers, power saws, etc.

Here we have allowed ten minutes to select tools and get to the point of installation. Remember that we are dealing with an ordinary industrial project. Multi-story buildings, power plants and other complicated projects require a more generous allowance.

Many buyers think that because they are paying for eight hours a day, mechanics should spend that much on-the-job time actually installing work. Contractors know this is not practical.

Coffee Break: The coffee break is of recent origin and most of us believe that mechanics are entitled to it. Besides affording the men a brief and pleasant respite, it often pays dividends. It stimulates, relieves tension and builds up morale.

On large projects, arrangements can be made to have fresh, hot coffee delivered right to the men. If it is not convenient for management to supply it, men must bring their own.

Very often, on small projects, the coffee break is prolonged. But time is not wasted. While men have time out, they talk over and plan their work.

Lunch Periods: The 30 minutes

AFTER 30 YEARS ON THE JOB . . . Okolite insulation still looks good. This unretouched photograph shows a section of 11.5 KV power cable recently re-assigned by Duquesne Light Company. Notice that the insulation is still flexible and resilient—workable. Tests show the tensile strength has deteriorated very little, remaining more than 33% above the original specification figure.

How long does an Okonite cable last?

30-year-old Okonite cable still tests above specified values

Here's Okonite Cable'bility* at work. It's "Old Faithful"—a 1250 MCM, Okolite-insulated power cable, made by Okonite's *strip process* back in 1929, now serving reliably as a mine power feeder for Duquesne Light Company of Pittsburgh.

This time-proven cable started in service in the Roaring Twenties as an 11.5 Kv lead from switchyard to transformer, handling 15,000 KVA loads. By 1942 power demands had increased and the cable began fifteen years of full load operation, 24 hours a day.

Then in 1957, "Old Faithful" was replaced by a larger cable to handle a new 25,000 KVA load. At that time, the veteran Okolite insulation was pronounced perfectly suitable for the demanding tasks as a power feeder and was installed in its present location.

There are Okonite "Old Faithfuls" in use today in every application, providing circuit security for their users. That's because, as in 1929, Okonite still produces the most dependable cables available. The reason is Cable'bility*, which is synonymous with The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N. J.

*OKONITE Cable'bility...cable craftsmanship since 1878.

***where there's electrical power...there's* OKONITE CABLE**

8273

for high lumen output and intensity
from a compact light source, it's the

Guardian quartz/lite floodlight

Better heat dissipation . . . finned construction holds operating temperature well within lamp's most efficient range.

UL

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Compact size, high output . . . small 500 watt lamp produces 10,500 lumens.

Lifetime durability . . . heavy, cast aluminum housing, heat resistant tempered glass lens, all non-ferrous hardware that can't rust, never needs paint.

Long lamp life . . . iodine cycle reduces blackening and maintains efficiency while increasing the lamp's life to a conservative rating of 2000 hours.

Completely weather-sealed . . . hinged door has heavy gasket, positive screw-lock.

Complete application versatility . . . three models—wide, medium and narrow beams. One mounting bracket provides for pole, wall, overhead or base installation.

It's the most attractive, best designed fixture of its type available! Get all the facts.

Write today for the ***quartz/lite*** Bulletin. Address Dept. E.

GUARDIAN LIGHTING

Guardian Light Company

500 NORTH BLVD. • OAK PARK, ILLINOIS

Representatives in All Principal Cities

ESTIMATING FORUM—XI

[FROM PAGE 134]

for lunch is established practice and the advisibility of a longer period will not be discussed. With this short period, additional time must be allowed for washing up and getting to and from the point of work. Allowance for this is not great, but along with other allowances, it adds up.

Other Listings: The reasons are obvious for time alloted to relief periods and closing time pick-up. Again, we must remember that a special type of project is being studied. Toilet facilities must be adequate if the 80-minute schedule is to be maintained.

Column "A"—Excessive

Having established the values in Column "B" as reasonable, we know that those for "A" are excessive. A glance at Column "A" shows no values radically higher than those in Column "B." Yet, the few minutes added here and there, plus the "lack of dispatch" item, gives a sizable total.

The total for Column "A" is 112 minutes greater than that for "B." That is almost two hours or 25% of an eight-hour working day. While some experiences have indicated that the amount is not excessive, 25% is an awfully excessive load to be put on any job.

Here, we have studied the effect of attitude on the work of the individual. In a crew, the attitude of one might effect the production of many others.

In a future article, other items effecting the productivity of the individual will be studied.

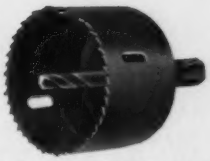
UPPER MIDWEST Electric Conference in Minneapolis, Feb. 19-21, was attended by Allen O. Killmer, Killmer Electric, Osseo, Minn., and Louis Kasperek, Minnesota Valley Electric, Lesueur, Minn.

Skil ball-bearing drills at these prices?

At only $32.50, the New **Skil Model 70** (*top*) stretches your dollars further than any industrial ¼-incher you can buy! Yet it's every inch a quality Skil tool, with ball-bearing construction; powerful 2.5 amp motor; precision helical gears; tough, lightweight aluminum housing.

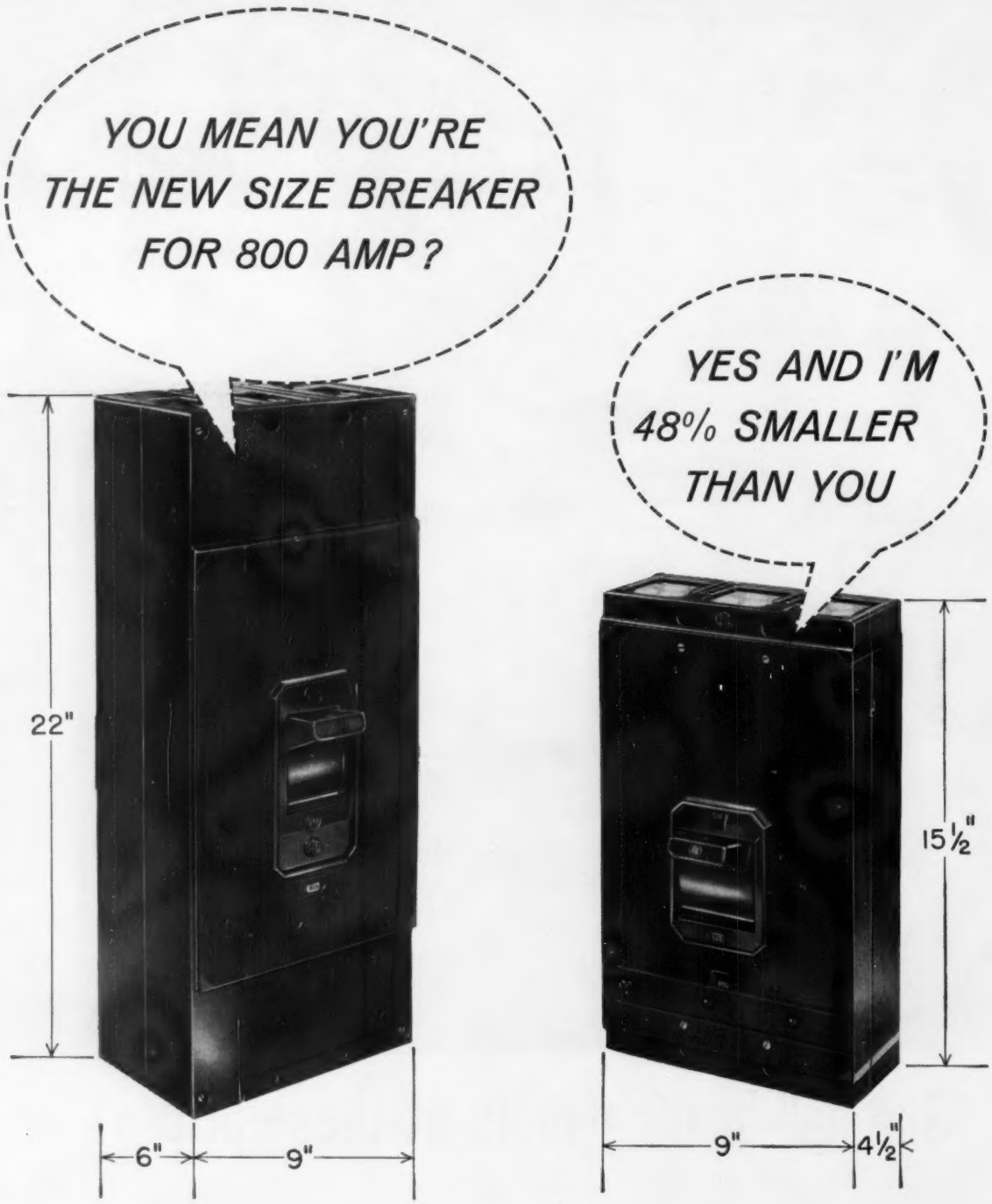
New **Skil Model 76** (*bottom*) is today's answer for buyers who want a broad-shouldered, ⅜-inch drill—low in price ($42.50)—but high in quality. Has ball bearing construction, lightweight aluminum housing. Auxiliary side handle gives better control, extra leverage when using hole saws and large bits.

See your Skil distributor for a demonstration. Look under "Tools-Electric" in the Yellow Pages. Or write: Skil Corporation, Dept. 130D, 5033 Elston Avenue, Chicago 30, Illinois.



Drill holes up to 1½" dia. with Models 70 & 76 and fast cutting Skil Hole Saws. Other hole saws up to 3½" dia. available.

SKIL . . . and SKILSAW POWER TOOLS



You're darn right 800 amperes. Yet this new I-T-E KM frame circuit breaker shaves 6½ in. off the height and 1½ in. off the depth for this rating. Handles 800 amp continuous, 50,000 amp interrupting at 240 volts, 25,000 amp at 600 volts. Send for full details. Write I-T-E Circuit Breaker Company, Dept. SA, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

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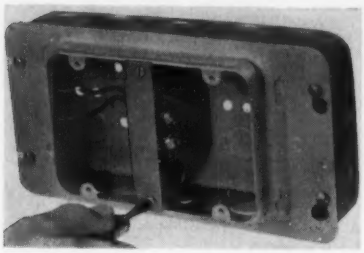
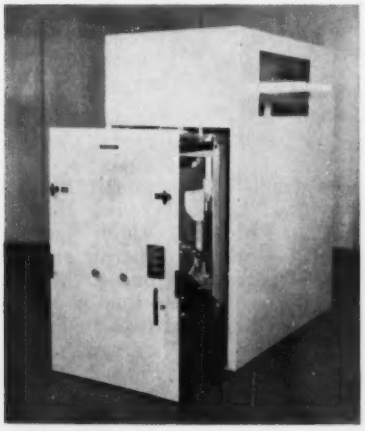
Product News



Transformers (1)

A complete line of low-voltage transformers, Easi-Mount, Series 990, features circuit-breaker protection and a variety of installation arrangements including flush mounting models. Developed to power residential and commercial door chime and signaling systems, the line includes two ratings of flush-mounting models. They fit flush into multi-gang outlet boxes. To guard against overload, the new 990 transformers contain self-restoring circuit-breaker protection. In addition to models rated at 5 watts 10 volts, and 10 watts 16 volts, the line will include a trivolt model, for applications requiring long wire runs from power source to transformer. Rated at 6, 12 and 18 volts, this unit will deliver 4.5 watts, 7 watts and 8.8 watts, at respective voltages.

Edwards Company, Inc., Norwalk, Conn.



Switchgear (2)

Developed to protect 2400- to 13,800-volt distribution circuits, new Type DFS drawout fused, metal-enclosed switchgear is available. It is intended for commercial, institutional, light industrial and other applications which require protective equipment. Catalogued as load-interrupter switchgear, it is built around a drawout design in which switch-and-fuse element is withdrawn from enclosure whenever fuses are to be replaced or switch contacts inspected. Equipment can be furnished for indoor or outdoor service, either as single-circuit units or as multi-circuit switching centers for service entrances and transformer primary or secondary switching. It is available in two voltage classes—5 and 15 kv—and in two switch ratings—600 and 1200 amps, continuous.

Westinghouse Electric Corp., P. O. Box 2099, *Pittsburgh* 30, *Pa.*

Connector (3)

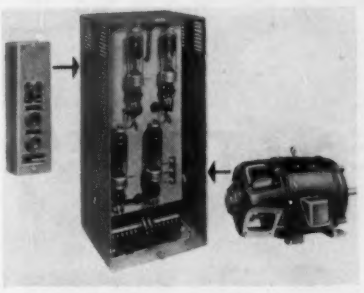
A new larger size crimp connector is listed by UL for combinations from one No. 14 with one No. 16, up to one No. 6 with two No. 8. A total of 1028 approved stranded and/or solid wire joints. It is listed by UL and CSA for general use, 600 volts, in branch-circuit and fixture wiring up to 75°C; 1000 volts when enclosed in signs or fixtures. Crimp sleeve is cadmium plated steel. When sleeve is crimped, double indents make contact at right angles to wire so sleeve cannot slide or twist. Insulator is made of polyvinyl chloride. Catalog data is available.

Ideal Industries, Inc., 1041 *Park Ave., Sycamore, Ill.*

Pushbutton Station (4)

A new heavy-duty pushbutton station of corrosion-proof, all-rubber, weather-sealed construction, known as the Flexitite Switch, is recommended for any 2-station pushbutton application, such as start-stop, up-down, forward-reverse, off-on, etc. The production model meets NEMA types 1, 4 and 5 enclosure requirements for both heavy- and standard-duty operation. Switch fits all standard FS and FD boxes. In addition, flush mounting can be achieved on metal surfaces. It incorporates micro-type one- or two-pole switches tailored to specifications, with normally open and/or normally closed contacts. Bulletin B82 is available.

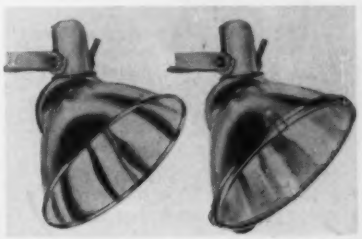
Joy Manufacturing Co., Electrical Products Div., 1201 *Macklind Ave., St. Louis* 10, *Mo.*



Adjustable-Speed Drive (5)

A new adjustable-speed drive with a speed range from 2:1 to 100:1 is now available. Maximum and minimum speed limits are easily adjusted within the controller to specific applications. The new drive operates from a single-phase ac supply. A pair of grid-controlled thyratrons and diode tubes provide full-wave rectified voltage to the drive-motor armature. Drive also provides short-circuit protection, under-voltage and overload protection, a timed method of accelerating to preset speed, regulated speed reference supply, and tube circuits that fail-safe on filament burnout. Complete drive is designated Class 8833 Type BG, and includes the controller, pushbutton station and drive motor.

Square D Company, 4041 *North Richards St., Milwaukee* 12, *Wis.*

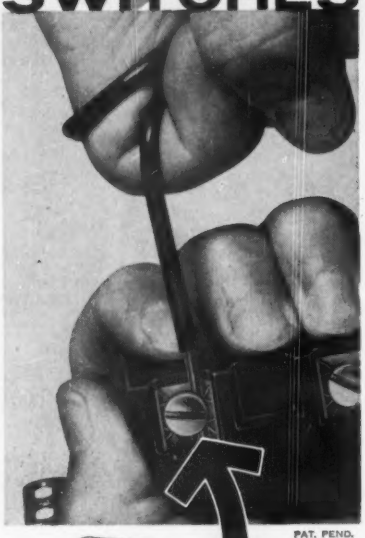


Floodlights (6)

The new "Econoflood" floodlights have an auxiliary inner-floating reflector providing more usable light. Five beam spreads provide a line of floodlights for all applications. Features are: one-piece weathertight aluminum hood; duo relamping design; locked in aiming design; uses incandescent or mercury lamp; wide range of mounting accessories—base, pole, pipe, vertical surface-mounting bracket.

Appleton Electric Co., 1701 *W. Wellington Ave., Chicago* 13, *Ill.*

NEW
SIERRA
Q-T
SWITCHES



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TITE-BITE
a terminal that combines the speed of back-wiring, and the visible inspection of side-wiring... with a grip so vise-like that looping is unnecessary.

SIERRA "Q-T" is the new quiet-type switch that can pass your most critical inspection. The "Q-T" is UL approved, meets all codes and standards. Moreover "Q-T" meets or exceeds all of the specifications normally applied to switches priced considerably higher.

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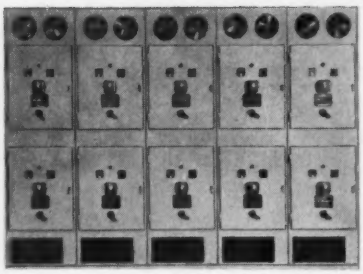
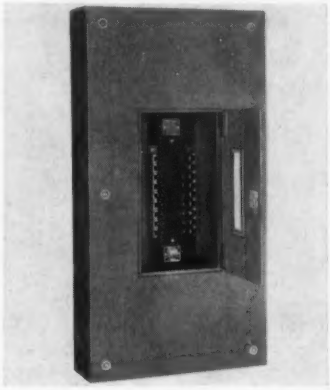
15100 SOUTH FIGUEROA STREET
BOX 85, GARDENA, CALIFORNIA
Write for more information and catalog



Charger **(7)**

New silicon-rectifier-type charger units can charge several electric, material-handling truck batteries simultaneously. Each Exide Multi-Circuit ETR (electric truck rectifier) contains two completely automatic, tapering-current charging units and control panels within a single cabinet. Each unit is designed for easy interconnection with other such units. The ETR cabinets can be mounted flush against a wall to save space. Largest standard twin-circuit ETR model, a 3-phase unit for charging 18-cell batteries rated at 1000 amp-hr capacity, protrudes only 33¼ in. (over-all) from the wall and is 25⅝ in. wide, 7 ft 4 in. high.

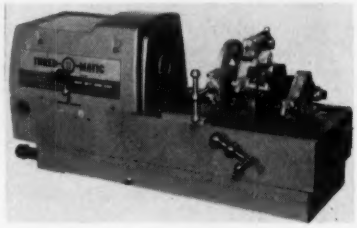
Exide Industrial Marketing Div., Electric Storage Battery Co., Philadelphia, Pa.



Panelboards **(8)**

A new line of combination lighting and power panelboards featuring the new Type NB breaker, is for applications requiring main-bus capacities ranging from 100 to 600 amps. They are designed for use in industrial plants and commercial buildings where it is desired to control lighting and power distribution from a single conveniently located electrical panelboard. Used in the NBLP panelboards are Type NB bolt-on breakers which provide overcurrent protection up to 70 amps, and are available in 1-, 2- and 3-pole units. All live parts are recessed. This is accomplished by using high-shock phenolic insulators, which support and enclose busbars the full length of the panel. Other features include copper-aluminum lugs to meet all installation requirements and galvanized-steel interior parts and enclosures, which give lifetime rust-proof protection.

Federal Pacific Electric Co., 50 Paris St., Newark 1, N. J.



Threader **(9)**

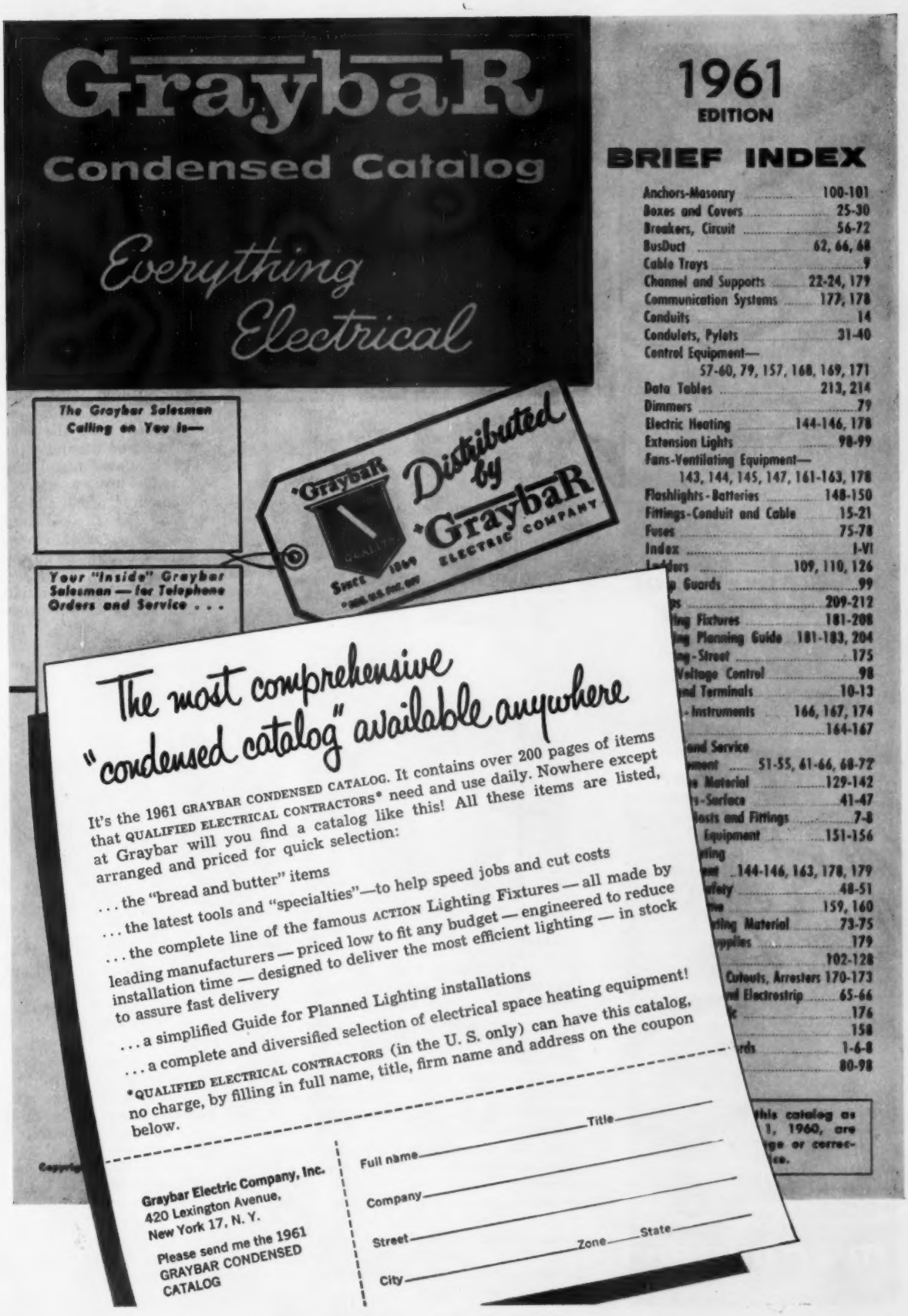
A new pipe, conduit and bolt threader, called Thred-O-Matic "22-A" is available. Features are totally enclosed, automatic double chuck; six-brush motor; specifically designed for make-up or tear-down of fittings; choice of mono, dual or universal die heads with built-in automatic oil flow; new offset cutter on carriage; interchangeability of position of cutter and reamer assemblies. Range of the "22-A" is ⅛ in. to 2 in. in pipe and conduit, and ½ in. to 2 in. in bolt. Brochure is available.

Collins Machinery Corp., 955 Monterey Pass Road, Monterey Park, Calif.

Troffer **(10)**

A completely new concept in air-handling troffers called Triple-Shell Lumi-Flow. Units provide light, cool air or warm air from a single concealed ceiling fixture. A feature of this new line of equipment is that the air passageway is completely isolated from the troffer housing by fiberglas insulation and an insulating air gap, thus removing the possibility of temperature variations affecting the light output of the unit. Air-handling capacity of these units handles from 0 to 20 cu ft per minute from a single 1- by 4- or 2- by 4-ft unit. Unit is 4⅝ in. deep.

Benjamin Division, Thomas Industries, Inc., 207 East Broadway, Louisville, Ky.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• CHOICE, of diffusers: Holophane prismatic Controlens,® tempered Fresnel Lens, heavy molded Carrara glass, or Herculite (for high security applications)

Complete specification data sheets on request Section A pages 9-10 9a-10a

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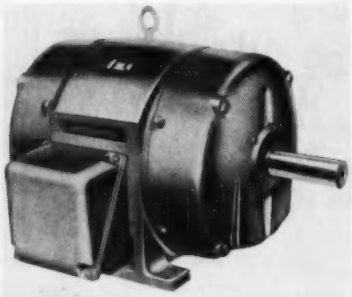
LIGHTING
1329 Willoughby Ave Brooklyn 37 N Y

Cable Tray (11)

A new ladder-type cable tray called "Ladderway" is made to support long stretches of heavy-insulated power cables with straight runs and various turns in mills, factories, generating stations. It is available in galvanized steel with standard straight sections of 10 ft and a depth of 3 in. The rectangular rungs have rounded edges to prevent damage to the cable insulation, and there is a choice in rung spacings of 4, 8 and 12 in., as well as various widths. Sections are joined together by a single-bolt connection that is easily driven into place.

Delta-Star Electric Div., H. K. Porter Company, Inc., 2437 *Fulton St., Chicago* 12, *Ill.*



Motors (12)

Part-winding motors have two separate parallel stator windings. When starting, one of these windings is energized first before the complete winding is placed across the line. Except for this, part-winding motors are electrically similar to standard squirrel-cage motors. For starting, part-winding motors require no voltage-reducing elements. Transition from one to two windings is inherently closed circuit. Controls used with part-winding motors may be either 2-step or 3-step design, depending upon desired limitations to starting inrush current. Motors are available with a variety of mountings and enclosures, and are designed for operation on power supply of all standard voltage and frequencies. Bulletin 1030 is available.

Howell Electric Motors Co., 16316 *West Seven Mile Road, Detroit* 35, *Mich.*

Power Protectors (13)

New safety features have been introduced on LB-1 power protectors. With a 200,000-amp interrupting capacity, the units are rated up to 480 volts ac, 800 to 4,000 amps continuous. A special circuitry for single-phase protection opens all contacts when any single fuse blows. A blown-fuse indicator automatically pops out, simplifying replacement. Contacts cannot be reclosed until the fuse has been replaced and the indicator reset. A new insulated pistol-grip operating handle uses a stored-energy mechanism to provide high-speed reclosing. For all operating conditions—including load, overload, and fault switching up to the maximum interrupting capacity—either the switch or CLF fuse will adequately and safely open the contact.

General Electric Co., Low Voltage Switchgear Dept., Philadelphia, Pa.

Unions (14)

A new line of all-aluminum, explosion-proof unions feature small exterior dimensions. Two models are available, the EUF series with female ends, and the EUM series with a male end and a female end. Body and ring of unions are tapered to provide a positive seal if an interior explosion occurs. Listed by UL and CSA. Reducing the over-all size allows parallel conduit to be placed closer together, as well as more flush with walls. Sizes are provided to handle ½- through 2-in. conduit. Catalog is available.

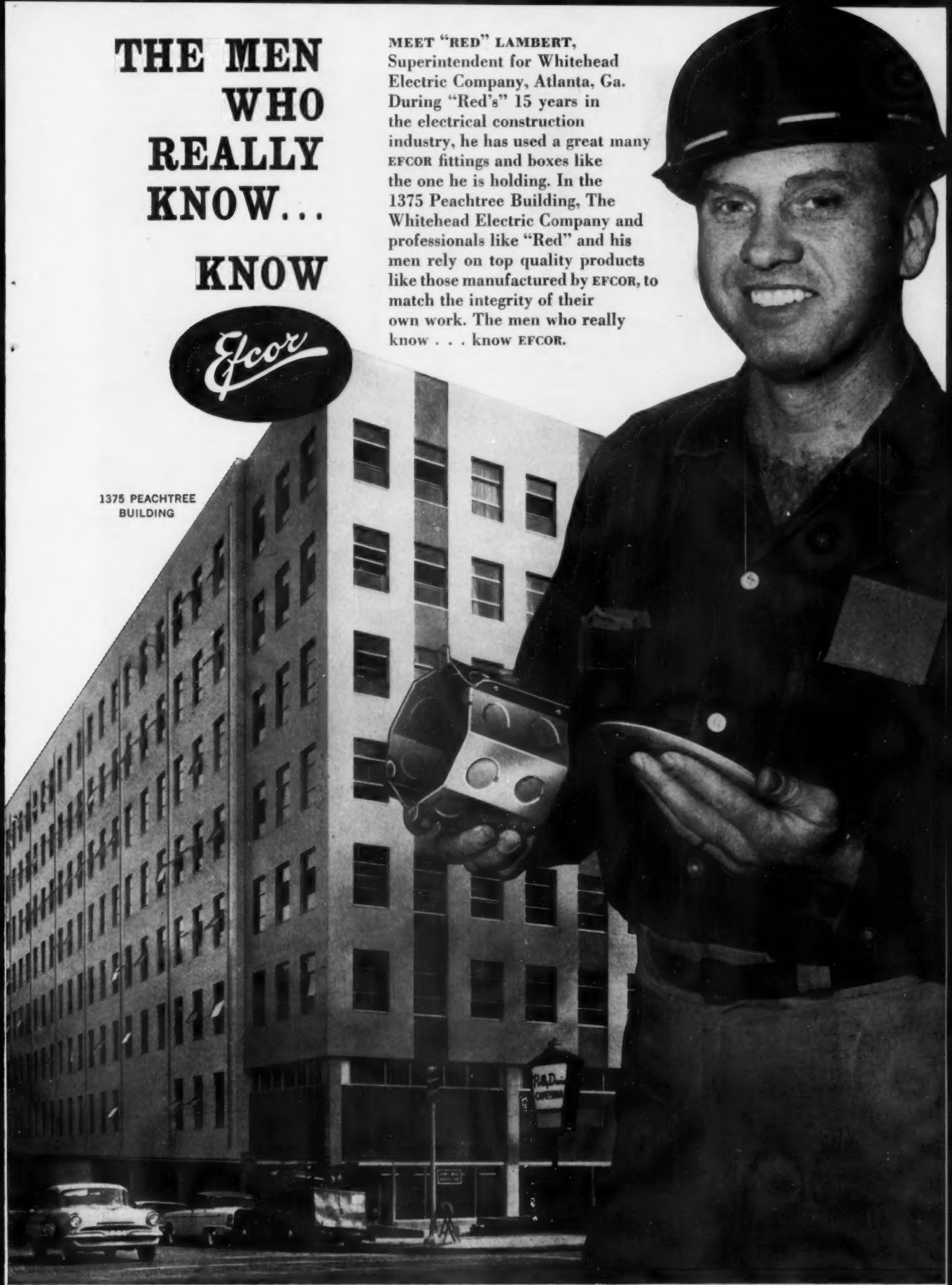
Killark Electric Manufacturing Co., 3940 *Eastern Ave., St. Louis* 13, *Mo.*

THE MEN WHO REALLY KNOW...

KNOW

Efcor

MEET "RED" LAMBERT, Superintendent for Whitehead Electric Company, Atlanta, Ga. During "Red's" 15 years in the electrical construction industry, he has used a great many EFCOR fittings and boxes like the one he is holding. In the 1375 Peachtree Building, The Whitehead Electric Company and professionals like "Red" and his men rely on top quality products like those manufactured by EFCOR, to match the integrity of their own work. The men who really know . . . know EFCOR.



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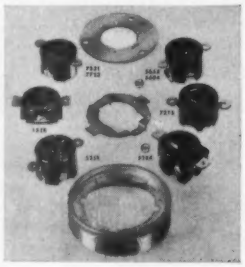
Shorter styled, modern, flanged duplex telephone and receptacle nozzles in satin brushed brass or anodized aluminum. Standards fit ½" opening. ¾" stems available. Also grounded receptacles.

***Adjustable* STEEL BOX**

This is our #190 series, with a 3¼" brass cover plate. Comes in two standard heights — 3⅛" and 2⅜" minimum. Designed for power or telephone service. A "KEY" (shown in center of photo below) which fits most popular size and style receptacles has been added at no extra cost.

Adjusting ring for our 190 series is so designed that KEY drops easily into special slots. You select the receptacle required and simply "LAY-IN"; then "LAY-ON" receptacle ring. That's it.



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Watertight Floor Box — 3½" or 4¼" brass cover plate with 2" or 2⅜" abandon plug for power or ½", ¾" or 1" for telephone service or duplex receptacle nozzles. Equipped with ground wire.

Insulator Supports

Malleable iron clamps of high tensile strength. Fastens to steel framework without punching holes. Four sizes— 1", 1½", 2" and 2½".

Write for Complete Catalog

Sold only thru Wholesalers

Fullman Manufacturing Co.

1209-1215 JEFFERSON STREET

LATROBE, PA.

Connector (15)

The ½-in. Flex clamp-type connector No. 202 is listed by UL and CSA. Body of connector is of die-cast construction. Cadmium-plated steel is used for heavy-duty clamp and knockout. Connector is available with either locknut on or off.

Allen-Stevens Conduit Fittings Corp., 33-53 62nd St., Woodside 77, N. Y.

Trencher (16)

A new model, the W-1 Pow-R-Ditcher, digs up to 8 in. wide and is used primarily by contractors, utilities, custom operators and plumbers for laying small service and electrical lines. It features all-hydraulic ground travel. Unit has 4-wheel drive on 4.00x8 tires or is equipped with crawler tracks. It is powered by a 9-hp Wisconsin AENL engine. Special ejector paddles allow dirt to be deposited on both sides of ditch. The boom is raised and lowered hydraulically.

Vermeer Manufacturing Company, Pella, Iowa

Controllers (17)

A new line of oil-well pumping controllers for use with standard or inherently protected KOF motors. The units, designated CR148 and CR7008, are specially designed for outdoor operation in oil-field applications requiring full-voltage starting of polyphase motors up to 100 hp. Rated at either 220 or 440 volts, the new standard line comes in NEMA sizes 0 through 4. Units offer 4-way protection against undervoltage, overloading, short circuits and lightning. Special units of the new line, rated 220 or 440/762 volts, may be used with GE Tri-Clad '55' motors equipped with the new Thermo-Tector system inherent overload protection. Two methods of programing and restarting are available. First method uses a program timer with a built-in random-sequence restart feature. Program timing of pumping cycle is controlled by toggle tabs that permit 24-hour cycles with intervals as short as 15 minutes. Other method available uses separate program timer and separate definite-sequence restart timer.

General Electric Co., Schenectady 5, N. Y.

Duplex Receptacle (18)

A new U-ground duplex receptacle, called "Biplex," is listed by UL and meets all applicable codes and standards for 15-amp, 125-volt devices. Biplex is the same shape and size as Triplex and fits the same wall plates. Tite-Bite terminal feature incorporates the speed of back wiring with the visually-positive inspection of side wiring.

Sierra Electric Corp., 15100 S. Figueroa St., Box 85, Gardena, Calif.

Transformers (19)

For installation in areas classified as hazardous locations under the NEC, this line of transformers provides a shield between input and output windings to permit grounding. This type of transformer is a code requirement for Class I Div. 1 locations in which hazardous concentrations of flammable gases or vapors exist continuously, intermittently or periodically, under normal conditions, during maintenance, because of leakage or during breakdown or as a result of faulty equipment. Ratings are from 100 watts to 50 kva, 120-volt input and output.

Acme Electric Corp., Cuba, N. Y.

Chosen to protect your children

. . . a prime essential to all business construction

Chances are great that you pass a Gamewell fire alarm box on your way to work, because a vast majority of all municipal fire alarm systems are Gamewell systems!

For over 100 years Gamewell fire alarm boxes have stood as silent sentinels in thousands of communities. The lives and the property these systems have saved are testimony of their unerring reliability. Similar Gamewell interior fire alarm systems, with the same high standards and offering the same reliability, can be planned as part of complete plant and institutional fire protection. Safety is everybody's business . . . *our* profession.

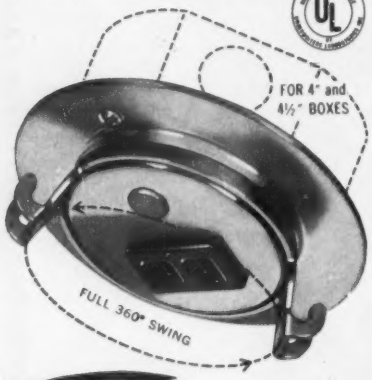
Send for your Gamewell Flexalarm catalog with typical fire alarm installations, see how you can plan maximum protection at minimum cost. Write THE GAMEWELL COMPANY, 1317 Chestnut Street, Newton Upper Falls 64, Massachusetts. A Subsidiary of E. W. Bliss Company.

BLISS Gamewell®

FIRST... WHEN SECONDS COUNT

Hanging Fixtures?

Just ATTACH . . .
HANG . . . TWIST



IDEAL

"Three-Sixty"

FIXTURE HANGERS

SIMPLE, EASY, SWIFT . . . screw hanger on box—forget alignment . . . hang fixture on small, compact arms . . . then, align fixture instantly with a twist of the wrist!

EXCLUSIVE FRICTION RING suspension rotates all the way around, 360°

10 RECEPTACLE CHOICES—one for every job—an Ideal exclusive.

BRIGHT CADMIUM PLATED for neat, attractive installations.

HANGING CAN BE DONE with 2 or 4 chains, or S hooks.

"LOW COST" HANGERS ALSO AVAILABLE
38° swing. Ground fixtures to systems. 2 or 3-wire models. 2 5'-chains. Hooks and cord clips supplied.

GET THE FACTS . . .
send coupon

IDEAL INDUSTRIES, Inc.
1041-D Park Ave., Sycamore, Ill.
Send Fixture Hanger Catalog

Name_____
Company_____
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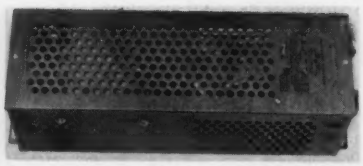
City_____ Zone____ State_____

Sold Through America's Leading Distributors



Transformer (20)

A new 2-lamp parallel mercury transformer that keeps one lamp burning should the other fail is now available. Circuiting of transformer provides complete electrical independence between two lamps, with negligible interaction. Failure of one lamp does not significantly affect operation or light output of remaining lamp. Constant-wattage principle is a standard feature in the new transformers, insuring a regulated, safe power flow to the remaining lamp. Primary current drops when an open- or short-circuit condition occurs in lamp circuit. Transformers are available in both indoor and outdoor weatherproof designs and in several primary-voltage ratings.

Sola Electric Co., Elk Grove, Ill.

Control (21)

A new type of sequence control for electric heating furnaces has been introduced. Thermal rods instead of bi-metal strips provide the necessary time delay in turning on the different heating elements one by one. Stainless-steel thermal rod is heated by a small electric coil activated by the room thermostat. As the rod becomes elongated from the heat, it closes a switch on the main heating circuit. The control is furnished in modules corresponding to the number of heating elements in the furnace.

Controls Company of America, Schiller Park, Ill.

Circuit Breaker (22)

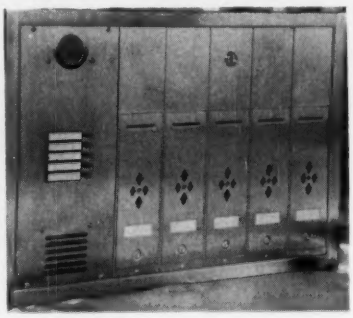
A new 800-amp molded-case circuit breaker, designated KM frame, is smaller than its LM predecessor by one frame size, and provides the same electrical features and ratings of LM units. The KM breaker is available in 2- and 3-pole construction in current ratings of 125 through 800 amps, for 600 volts ac and 250 volts dc. Height of KM is 15½ in., depth 4⅛ in. The smaller size permits more units to be mounted in a standard switchboard, while distribution and power panelboards can be built shallower because of unit's reduced depth. Standard features on the KM unit include enclosed terminals and front adjustable instantaneous trips. Pressure wire connectors are available for front-connection of breakers in panelboards, individual enclosures and control cabinets. Rear connecting studs and plug-in connector assemblies are available for switchboard mounting.

I-T-E Circuit Breaker Co., 1900 *Hamilton St., Philadelphia* 30, *Pa.*

Conduit (23)

Three types of conduit, electrical metallic tubing, rigid steel and aluminum conduit, are now available. Rigid steel conduit is hot-dipped galvanized, with threads that are specially treated to prevent rusting. EMT is electro-galvanized. Interior surfaces of rigid steel conduit and EMT are finished with baked-on lacquer, while rigid aluminum conduit is given a special factory coating. Both aluminum and steel conduit come with couplings attached and with color-coded plastic thread protectors. They are listed by UL and comply with all Federal specifications. Literature is available.

Nikoh Tube Company, 5000 *S. Whipple St., Chicago* 32, *Ill.*



Telephones (24)

Transistorized vestibule telephones, with built-in amplifiers, make talking easier and clearer between the vestibule and individual apartments. These phones, combined with call-button plates, mail boxes and directories, form modular units which can be selected to make up custom installations. Thirty-six basic apartment house telephone systems offer a wide range of services. Bulletin 128A is available.

S. H. Couch Co., Inc., 3 *Arlington St., North Quincy* 71, *Mass.*

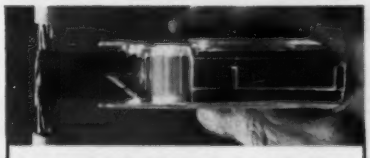
New from Johns-Manville!

Now! Tape...and tear...with one hand!

THIS BRAND-NEW DISPENSER makes handling plastic electrical tape a revelation! Far safer, too, because the cutter is permanently shielded . . . can't snag hands or clothes.

From beginning to end, you'll save time and trouble with J-M *Dutch Brand* Plastic Electrical Tape in this great new dispenser. And you'll like *all ten* of the big advantages shown on the right.

But, see for yourself! Get all the facts on Dutch Brand® Plastic Electrical Tape in the handy new dispenser from your J-M Dutch Brand Distributor. Or write to Dutch Brand Division, Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ont. Cable: Johnmanvil.



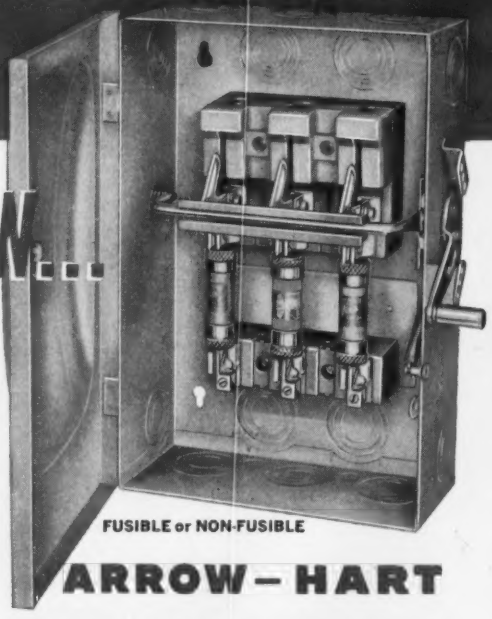
TEN IMPORTANT ADVANTAGES!

1. *Permanently shielded cutter!* 2. *No moving parts to snag hands, clothes!* 3. *Can't dull or clog!* 4. *"Tape-and-tear" with one hand!* 5. *Special "grip-strip" for faster starting!* 6. *Full 66' of finest plastic electrical tape made!* 7. *Preloaded . . . ready to go!* 8. *Protects tape against dirt, grease!* 9. *Big center hole for easy handling!* 10. COSTS NO MORE THAN TAPE ALONE!

JOHNS-MANVILLE
DUTCH BRAND ELECTRICAL TAPE

JOHNS-MANVILLE JM PRODUCTS

PERFORMANCE PLUS PROTECTION



NEW...

240, 480 and 600 VAC

250 VDC

FUSIBLE or NON-FUSIBLE

ARROW–HART

100 AMP HEAVY DUTY SAFETY SWITCH

For Commercial and Industrial Installations . . .

these new switches are designed for safe operation, dependable performance, and provide positive protection for the user. Design and construction features include:

VISIBLE BLADES . . .
show at a glance the switch is in the "OFF" or open position.

DEAD-SAFE DESIGN . . .
switch cannot be operated when cover is open.

INTERLOCKING INDICATING COVER . . .
can only be opened when switch is in "OFF" position.

QUALITY CONSTRUCTION . . .
with knife blade contacts and all current-carrying parts silver plated.

COMPACT DESIGN . . .
providing maximum wiring space in gutters.

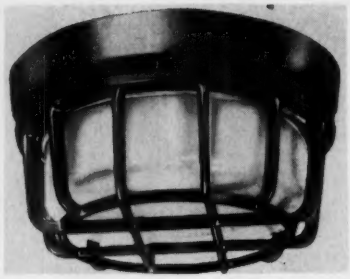
Supplied with NEMA I (General Duty) enclosure. Available with 2, 3 or 4 poles. Write for details to The Arrow-Hart & Hegeman Electric Co., Dept. ECM, 103 Hawthorn St., Hartford 6, Conn.

ARROW AH HART

Quality since 1890

ENCLOSED SWITCHES • WIRING DEVICES
MOTOR CONTROLS • APPLIANCE SWITCHES

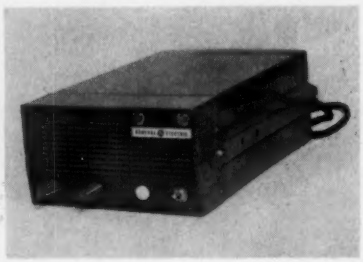
ARROW AH HART



Lighting **(25)**

Newly revised contemporary design in vaportight lighting, 43-99 Series. Available in either anodized cast aluminum or matte natural cast bronze, with or without hinged cast protective guard. UL listed "enclosed and gasketed" (vaportight) for use with two 60-watt lamps. Supplied complete with junction box, gasket and four mounting screws. Optional finishing collar is designed to conceal exposed outlet box when conduit cannot be recessed. Fixture is suitable for lighting shower rooms, locker rooms, loading platforms, washrooms, under canopies and marquees and in the chemical and petroleum industries.

McPhilben Manufacturing Co., Inc., 1329 *Willoughby Ave., Brooklyn* 37, *N. Y.*



Two-Way Radio **(26)**

A new line of compact two-way radios, called G-E Pacer, for electrical contractors and appliance specialists. Designed for operation in low band (27-50 mc) and high band (150-174 mc), the units have full-quality VHF-FM audio. The Pacer has 15 tubes and two transistors. When the 15-watt unit is "on," battery drain is 4.2 amps. Control section contains a transistorized power supply adaptable to 12-volt negative or positive ground electrical systems. Pacer model is 4¼ in. high, 7¾ in. wide and 12½ in. long, a total of 412 cu. in. Lightweight, aluminum construction is used.

General Electric Co., Lynchburg, Va.

...AND YOU DON'T HAVE TO CHANGE YOUR FIXTURES!

NEW WESTINGHOUSE HIGH EFFICIENCY LAMPS GIVE YOU 1/3 MORE LIGHT AT NO EXTRA COST!

YOU'RE LIGHT-YEARS AHEAD WITH WESTINGHOUSE . . . and the brightest, most economical fluorescent lamps you can buy! Now you can increase lighting levels without changing a single fixture . . . without increasing power costs . . . and without paying premium lamp prices. New Westinghouse "High Efficiency" fluorescent lamps give you a full third more light than daylight lamps . . . and 15% more light than cool white lamps . . . without consuming an extra watt of power!

"H.E." lamps are so new even the color tint is different—and only Westinghouse has it! A special blend of phosphor particles coating the inside of each lamp provides the higher lumen output . . . with a pleasant and restful green tint. Users everywhere feel this new green-white light gives a softer, more comfortable light . . . the most efficient light yet. Try "H.E." lamps in an entire area. If you don't agree that they provide the most efficient light ever, we will gladly exchange them for any Westinghouse fluorescent, any color shade, of your choice!

With "H.E." and other Westinghouse lamps, the Westinghouse Lighting Cost Reduction Plan gives you one or more of these benefits:

1. **Reduced cost of lamp purchases!**
2. **Reduced lamp replacement labor costs!**
3. **Increased lighting level for the same or lower costs!**
4. **More efficient use of power!**

Order new Westinghouse "H.E." lamps today and get more information on the Lighting Cost Reduction Plan from your authorized Westinghouse Lamp Agent or your nearest Westinghouse Lamp Sales Office! *You can be sure...if it's Westinghouse.*

Westinghouse

Westinghouse Lamp Division, Westinghouse Electric Corporation, Bloomfield, New Jersey

WEIGHT

REYNOLDS ALUMINUM RIGID CONDUIT

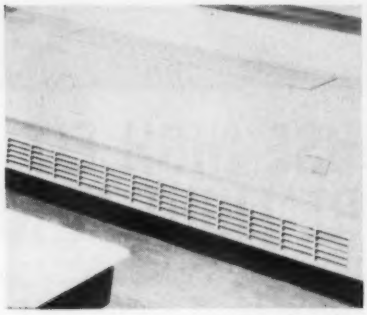
★ Easy to Cut
★ Easy to Thread
★ Easy to Handle
★ Easy to Bend
★ Less Voltage Drop
★ Locally Stocked

For complete information and names of Reynolds Aluminum Rigid Conduit Distributors, call your Reynolds Sales Office, or write: *Reynolds Metals Company, Box 2346-ET, Richmond 18, Virginia.*

Meter Socket-Load Centers (27)

A new line of combination meter socket and plug-in load centers within the same raintight enclosure is suitable for use as service entrance equipment. Both surface and semi-flush types are available, with and without main-breaker disconnects. Meter socket has lay-in type connectors with pressure plates, listed by UL for use with copper or aluminum wire. Features include plug-in construction; sequence bussing; neutrals on top near main; hinged cover provided with a special door stop to hold it open; easily removable dead-front shield. Entire enclosure is constructed of zinc-grip, corrosion-resistant steel finished in gray Melamine enamel. Semi-flush models provided with nailing strip flanges.

Murray Manufacturing Corp., 1250 *Atlantic Ave., Brooklyn* 16, *N. Y.*



Unit Ventilators (28)

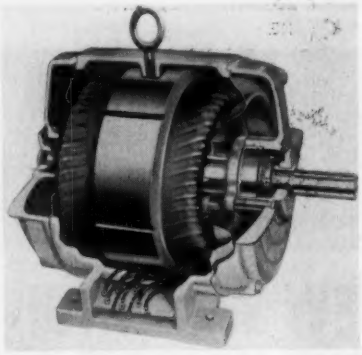
A new Model NU series of Chromalox unit ventilators are designed to provide all-electric comfort in new schools and school remodeling projects. In classrooms, the units are installed along window walls, either individually or in conjunction with draft-barrier storage cabinets. Units are offered in air capacities ranging from 600 to 1500 cu ft per minute. Each contains Chromalox Fintube heating elements having large heat-transfer surface and built-in over heat protection. Fans are direct-connected to individual uni-bearing, lifetime lubricated motors. Motors may be operated at three different speeds and are equipped with built-in thermal overload protection. Throw-away, renewable or permanent media, one-piece filters are available. A single control damper assures positive flow of outdoor air for ventilation and cooling.

Edwin L. Wiegand Company, 7500 *Thomas Blvd., Pittsburgh* 8, *Pa.*

Underfloor Duct (29)

A complete new line of underfloor duct has been announced. The underfloor duct will be added to the already existing line of cable trough and ladder for wire- and cable-handling systems in industrial and commercial applications. The single- and double-capacity underfloor duct and header duct incorporate many unique design features and installation economies, such as a special anti-corrosive finish and square aluminum-alloy junction box for accessibility.

T. J. Cope Div., Rome Cable Corp., Collegeville, Pa.

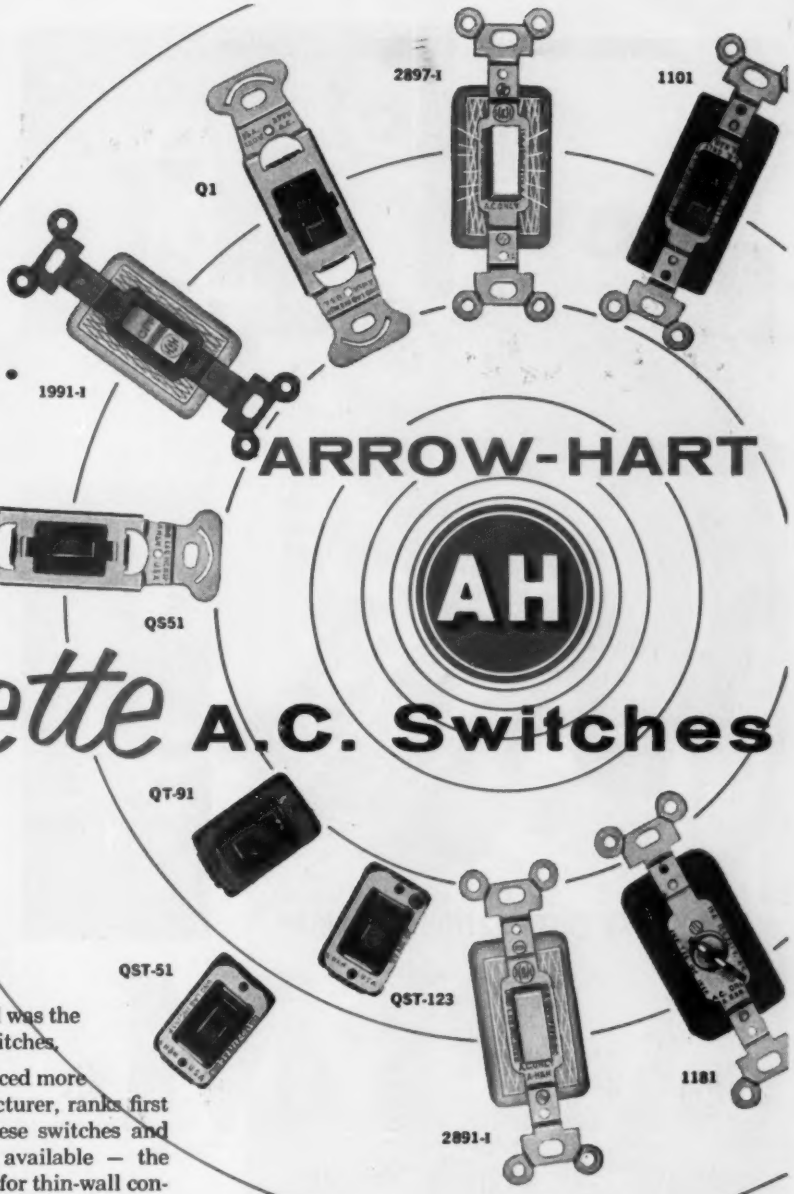


Insulation (30)

"Capsular" insulation system for encapsulated random wound ac induction motors has been announced. They offer added protection against moisture, chemicals, oils and abrasive contaminants. The conventionally wound stators feature heat-resistant, plastic-resin that completely seal end coils and fills spaces between wires in stator slots with a moisture-proof, chemical-resistant, protective sheath. Capsular insulation system can be supplied on open, drip-proof motors, 4450 frame sizes and smaller, 600 volts and below. Bulletin No. 3750 is available.

Louis Allis Company, 427 *E. Stewart St., Milwaukee* 1, *Wis.*

a family of Quality...



Quiette A.C. Switches

Only Yesterday . . . Arrow-Hart pioneered in creating the first switch featuring quiet, mechanical action, and was the first to offer a complete line of quiet switches.

Today . . . Arrow-Hart, having introduced more quiet switches than any other manufacturer, ranks first in the design and development of these switches and now offers the most modern switch available — the Space-Saver Quiette Switch. Designed for thin-wall construction, the Space-Saver Quiette Switch is a further addition to Arrow-Hart's full line of Quiette A.C. Switches — the most complete line available!

Whatever your specifications, there's a member of the Arrow-Hart Quiette Switch family engineered for the application.

Write for your copy of the new folder, "The Complete Quiette Switch Line," Form No. 327-G1371 to The Arrow-Hart & Hegeman Electric Company, Dept. ECM, 103 Hawthorn Street, Hartford 6, Conn.

H&H *SWITCHES SHOWN INCLUDE H&H SPECIFICATION GRADE.*

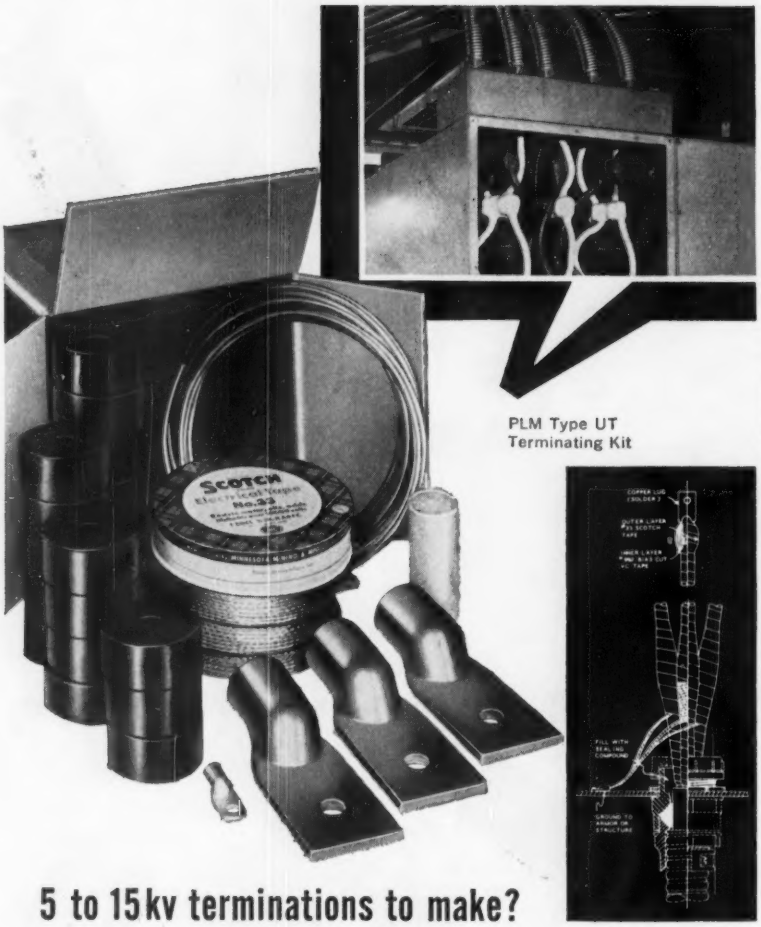
Listed as standard by Underwriters' Laboratories. UL

ARROW AH HART

Quality since 1890

WIRING DEVICES • MOTOR CONTROLS • ENCLOSED SWITCHES • APPLIANCE SWITCHES

WHEN YOU THINK OF WIRING DEVICES, THINK OF ARROW-HART



PLM Type UT
Terminating Kit

5 to 15 kv terminations to make?

There's a PLM Kit

to simplify the job!

Why take chances on incorrectly designed cable terminations and splices—or on having all the materials on hand that are needed to make them correctly?

PLM Terminating Kits and PLM Splicing Kits each contain the proper amount of all materials needed for one correctly designed termination or splice, together with clear, step-by-step instructions for making them. They eliminate need for ordering and stocking many separate items . . . simplify and speed up any job of cable installation or repair. PLM kits are supplied for terminating or splicing interlocked armored cable and non-metallic sheathed cable, and for splicing lead-covered cable, in ratings through 23 kv. Write for 52-page PLM catalog 301, on your letterhead, containing complete listing of PLM kits and fittings.

PLM Products, Inc
TERMINATING AND SPLICING ACCESSORIES

3875 WEST 150th STREET • CLEVELAND 11, OHIO

Lighting Unit **(31)**

A new totally luminous fluorescent corridor light, called the Corvaire, is a single-lamp plastic-enclosed fixture designed for general foot-traffic areas where a high level of illumination is not required. Units are best applied when mounted in tandem as a single row down the center of a narrow corridor or stairway, or in multiple rows in wider passageways. End plates are supplied with each unit so that it is possible to mount them individually. They can be installed directly on ceiling or suspension mounted with stem or rod hangers. Unit is available in 4- and 8-ft lengths. It uses 40-watt rapid-start lamps.

Lighting Div., Westinghouse Electric Corp., Edgewater Park, Cleveland, Ohio.

Variable Speed Drive **(32)**

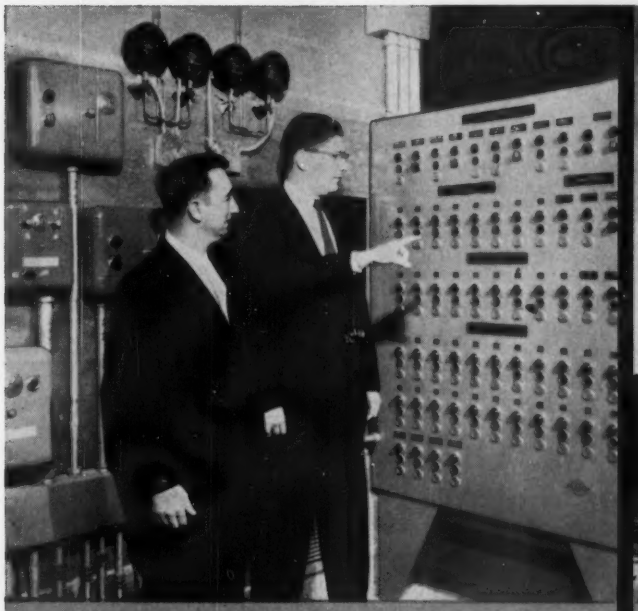
New "Lube-Free" variable-speed drive never requires lubrication. Shaft surfaces are impregnated with a special tough and wear-resistant material. The non-metallic bushings are also fabricated from a special material. Variable-speed drive can be installed in any location. They are produced in ¼ hp to 25 hp having output speeds from 4660 rpm to .4 rpm in speed variations up to 10:1. All drip-proof, totally enclosed fan-cooled, and explosion-proof variable-speed models are lube-free.

Sterling Electric Motors, Inc., 5401 Telegraph Road, Los Angeles 22, Calif.

Ballast **(33)**

New 2-light 40-watt certified rapid-start ballast is available. It is designed for cooler in-fixture performance. The new electro-magnetic design has improved starting characteristics at low end of primary-voltage range, assuring more reliability in starting. Ballast also features "up-side-down" design. Heat is no longer trapped inside ballast but is dispersed directly through metal of fixture housing. Ballast made in standard mounting dimensions and standard case size.

Sola Electric Co., Elk Grove, Ill.



Centralized control for all of the 59 heating and cooling units throughout the building is provided by this Arrow-Hart Master Push Button Panel. Consulting engineers Arthur Bigelson and S. M. Shefferman look it over.

BENDER BUILDING, Washington, D. C. Builder: Blake Construction Co.
Consulting Engineers: Shefferman and Bigelson.
Mechanical Contractor: Frank Blanch, Sr.
Electrical Contractor: Walter Toland Co., Inc.

SERVICE and QUALITY determine selection of ARROW-HART Motor Controls for Bender Building

ARROW-HART MOTOR CONTROLS used in the ultra-modern Bender Building, largest new office building in Washington, D. C. include across-the-line, reduced voltage starters, and push button controls for the heating, ventilating and air-conditioning motors. Centralized master panels operate all magnetic starters and controls for restaurant equipment and other special facilities.

ARROW-HART FIELD ENGINEERING SERVICE played an important part in assuring prompt, trouble-free installation of hundreds of individual motor control units by the electrical contractor. Working in close cooperation with the mechanical contractor, the temperature control supplier and the consulting engineers, Arrow-Hart's Field Representative coordinated all ordering information. The centralized control panels were pre-engineered for specific installation requirements.

Write for more information on Arrow-Hart Motor Controls and Service to The Arrow-Hart & Hegeman Electric Company, Dept. ECM, 103 Hawthorn St., Hartford 6, Connecticut.

All restaurant electrical equipment, including fans, compressors, pumps, etc., is controlled by this master push button panel custom-engineered by Arrow-Hart.

CONSULTING ENGINEER:
S. M. Shefferman of Shefferman and Bigelson . . . "Arrow-Hart met the rigid specifications that we demanded in the construction of this building."

MECHANICAL CONTRACTOR:
Frank Blanch, Sr. . . . "Arrow-Hart's Master Push Button Control Panel that provides centralized control should certainly save money in the operation of the 59 heating and air conditioning units."

BUILDING SUPERINTENDENT:
Robert McDaniel . . . "Arrow-Hart supplies good, durable equipment that does the job expected of it."

ARROW AH HART

Quality since 1890

MOTOR CONTROLS • ENCLOSED SWITCHES • APPLIANCE SWITCHES • WIRING DEVICES

Tool (34)

A new miniature-size, portable 2-speed hydraulic power pump weighing 14 lbs is capable of developing pressures up to 10,000 psi. Pump No. 1729 incorporates higher volume, low-pressure pumping features which provide fast-approach ram action with automatic changeover to low-volume, high-pressure drive. Pump is powered by a built-in 115-volt, ac-dc universal motor and is equipped with a built-in, 2-way control valve. For remote control operation, Model 1729-PO is offered with a pendant electrical switch and an extra length of electrical power cord.

Greenlee Tool Co., Rockford, Ill.

Receptacle (35)

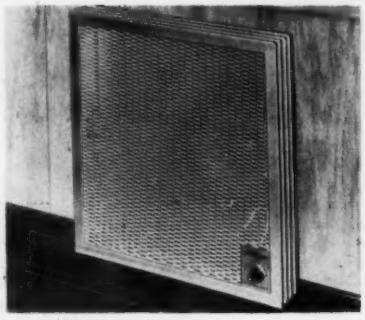
A new 20-amp, 125-volt duplex polarized grounding receptacle with riveted grounding contacts and terminals. This 2-pole, 3-wire type receptacle meets requirements of the latest revision of NEC. Suitable for commercial and industrial applications, configuration of receptacle face prevents insertion of parallel-blade plugs. The receptacle's U-shaped double grounding contacts and terminals feature a one-piece construction of heavy ⅛-in. thick bronze. This is mounted on strap by a brass rivet, headed on both sides. Unit is supplied for side wiring and back wiring, or side wiring only; is suitable for use with 4-in. outlet box covers. Receptacle is listed as standard by UL.

Arrow-Hart & Hegeman Electric Co., Hartford, Conn.

Starter (36)

Designed for fhp motors, a new Class 10 starter provides manual, across-the-line, start-stop or off-on control of fractional and 1-hp single-phase electric motors. Single- and 2-pole devices include a built-in trip-free thermal relay to protect motor from sustained overload. Two-pole starters are required to break both lines for dc applications, and are recommended for all severe ac applications. Two starters or a starter and a toggle selector switch in a single enclosure are also available. Toggle selector switch is used to connect circuit for either manual or automatic operation. Bulletin 10-B1 is available.

Furnas Electric Co., 1067 McKee St., Batavia, Ill.



Electric Heater (37)

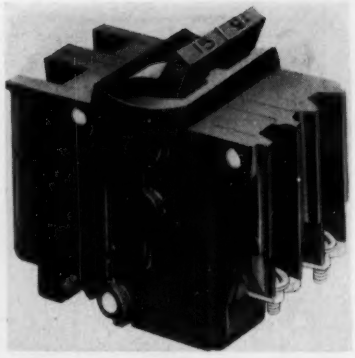
New "Compact" wall surface-mounted electric heater is 2¾ in. deep, 15 in. wide and 16 in. high. Heating elements are encased in steel sheaths for safety. The 500- and 750-watt models are available in 120 volts as well as 240 volts. All models are available with or without a built-in thermostat, for use as a supplemental heater without overloading existing house circuits. Listed by UL and manufactured to NEMA specifications.

Sun-Tron Corp., 7435 W. Wilson Ave., Chicago 31, Ill.

Exit Lights (38)

A new line of Multi-Mount exit lights in a choice of three lamp sources—incandescent, fluorescent or electroluminescent. Units are available in a variety of mounting methods—recess, surface, top or end mounting, and triangular. End, top-mounted and triangular exits include double faces. Multi-Mount exits are furnished with either cut-out metal letters or all-glass faceplates. Units are die formed of heavy-gauge, zinc-coated and phosphatized steel. Finished in a 300° baked-on Silvan. Brochure is available.

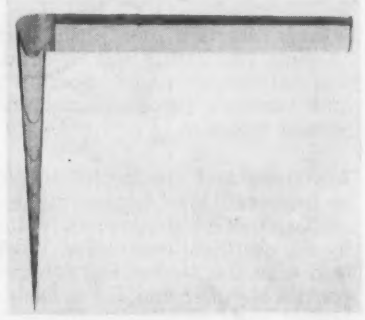
Edwin F. Guth Company, 2615 Washington Blvd., St. Louis 77, Mo.



Circuit Breakers (39)

A new line of Stab-lok circuit breakers and enclosures modified to meet the new 1959 NEC code requirements for non-interchangeability. The design change, however, does not obsolete existing Stab-lok installations as the new circuit breakers can be used in old or new devices. The line is based on a design whereby breakers are fitted with hardened steel clips that prevent breaker from being stabbed in until one or two knockouts in the enclosure are removed. The 15-amp and 20-amp breakers are installed by stabbing them in. To install 0-, 40- and 50-amp Stab-lok breakers, one knockout must be removed from back plate. For 60-, 70-, 90- and 100-amp sizes, two knockouts have to be removed.

Federal Pacific Electric Co., 50 Paris St., Newark 1, N. J.



Lighting Fixture (40)

Long-line fluorescent luminaires produced in 2-, 4-, and 8-ft modules for corridor and utility lighting have been announced. The housings of the S84 Series are constructed of die-formed, cold-rolled steel and bonderized after fabrication. The diffuser, extruded of white translucent, polystyrene, is unaffected by ambient temperatures.

Litecraft Manufacturing Corp., 100 Dayton Ave., Passaic, N. J.

PUSHBUTTON BENDS . . .

with perfect accuracy, and 3 times faster!

You can't help saving job time with Blackhawk's new 4" one-shot benders. You can get right up to the Optik Angle gage and *see* the angle you're bending. If you're using the new PA-600 electric pump for power, you have perfect fingertip control, too. Blackhawk benders have smaller rams for greater speed. And with the 2-speed PA-600, you're bending even faster. Results? The first fast way to bend pipe — that's easy!

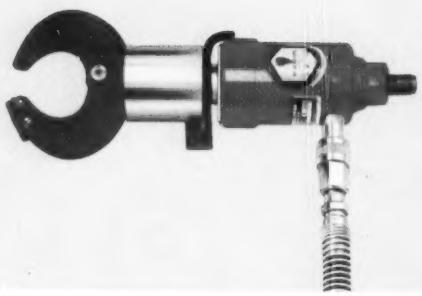
There is a Blackhawk bender for your every bending need. one-shot . . . segmental . . . and "thinwall." Many are multi-purpose. For *smoothest* bending of rigid and thinwall, steel or aluminum, in all sizes up to and including 4 inches!

BLACKHAWK® INDUSTRIAL DIVISION

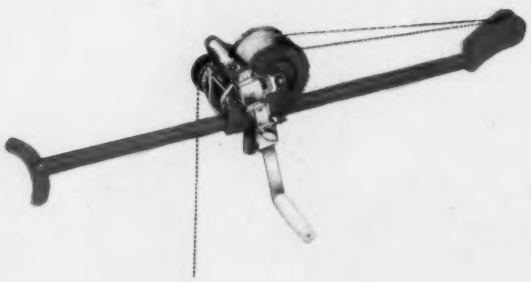
BUTLER, WIS.

SEE IT AT THE TOOL POOL -- ASK YOUR DISTRIBUTOR

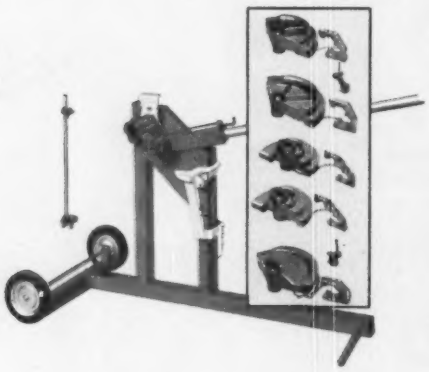
4 all new time saving tools



CABLE CUTTER Here's the newest Blackhawk tool — a cutter attachment for your hydraulic knockout set! The CS-100 cuts copper or aluminum cable up to 1,000,000 C.M. in just seconds. Reaches easily into inaccessible areas. Available also as a complete hydraulic set, the HS-100, with pump, hose and ram.



FLEX-A-PULLER One man can pull wire through conduit with the combined force of 9 men with this new 2-speed puller. It's easy to use. It's inexpensive. And it fits *any* outlet box. For runs up to 200 ft., or more with new "sidewinder" attachment, a CP-150 Flex-a-puller is the ideal answer.



RATCHET RIG The new all purpose mechanical bender for both rigid and thinwall. Specially designed frame adapts to a whole series of interchangeable shoes. Best way to get the fastest bends . . . the closest offsets. Bends all sizes of rigid and thinwall up to 1½". *Plus* 2" aluminum rigid conduit!

HAND BENDERS Three new lightweight aluminum hand benders are now made by Blackhawk. Each has an unbreakable level-type indicator. Precision cast close tolerance grooves in these benders are your assurance of wrinkle-free bends in both steel *and aluminum* thinwall. For ½" and ¾" rigid, too.

BLACKHAWK® INDUSTRIAL DIVISION
BUTLER, WIS. ***tools for electrical construction***

SEE IT AT THE TOOL POOL -- ASK YOUR DISTRIBUTOR

Lighting Unit (41)

A new outdoor luminaire that turns itself "on" at night and "off" in the daytime has been announced. Any standard NEMA photoelectric cell can be used with the unit. Unit is for parking lots, shopping centers, ramps, private roadways, outdoor work places and other areas where automatic operation is desired. Basic design uses an Endural glass-bowl refractor with optical prisms on inside and outside surfaces. Fixture parts are made of aluminum and stainless steel and the unit is engineered for use with incandescent or mercury-vapor lamps. Luminaire is suitable for mounting on poles or walls with standard brackets. Literature No. 442 is available.

Holophane Co., Inc., 342 Madison Ave., New York 17, N. Y.

Connector (42)

The 90° flexible-steel-conduit connector No. 201 is listed by UL for both ⅜-in. and ½-in. Flex. The die-cast body and cover are produced from high-grade metal conforming to the standards of the American Die Casting Institute.

Allen-Stevens Conduit Fittings Corp., 33-53 62d St., Woodside 77, N. Y.

Panels (43)

A complete line of weatherproof fusible pullout panels. The hinged cover enclosures are made of galvanized steel finished with gray hammertone enamel. Solderless box-lug connectors are suitable for aluminum or copper wire. All units have a welded hub on top, ample concentric knockouts in bottom and provisions for padlocking. They are suitable for 125/250-volt single-phase service with generous wiring room and grounded neutral. Model 600A contains one 60-amp pullout and 660A has two 60-amp pullouts wired in parallel. Both can be converted to 30-amp service through use of fuse reducers. Model 100A has a single 100-amp pullout, while two 100-amp units wired in parallel are mounted in 110A. Model 200A carries a 200-amp pullout. All are deadfront construction.

Hoffman Engineering Corp., Anoka, Minn.

Drill (44)

A new, portable core drill, known as the Ambassador, features a heavy-duty, high-torque 2-speed reversible electric motor. Using thin-wall diamond bits, it will bore holes through concrete, reinforced masonry, tile, glass, etc. It is for work involving heating and ventilating, air conditioning, plumbing, electrical, telephone lines, gas and water mains. Bulletin 27 is available.

Aker Drill Co., Inc., P. O. Box 830, Scranton 2, Pa.

Heaters (45)

New Chromalox controlled-beam electric-infrared comfort heaters with metal-sheath, quartz-tube or quartz-lamp elements. Fixtures are designed with deep housing shells to contain and control heating effect in a definite tight radiation pattern. A choice of heating elements provides a custom-type application of heaters to various conditions. These fixtures are especially adaptable for high, out-of-the-way mounting over work areas in commercial establishments, factories and warehouses. Weatherproof housing shell of each unit is of deep-recess aluminized steel construction. Reflector is polished aluminum. Eleven models from 8 in. to 54½ in. are available in the line. Bulletin F72100 is available.

Edwin L. Wiegand Company, 7500 Thomas Blvd., Pittsburgh 8, Pa.

"MARKETS UNLIMITED"

YOU CAN HAVE SUCCESSFUL PHASE CONVERSION

WITH THE

Add-A-Phase®

POWER CONVERTER

FRANK M. MARAS of FRANK'S ELECTRIC

Kincaid, Illinois . . . Reports:

"We have installed more than 100 ADD-A-PHASE Power Converters, which have given years of trouble free use. Because of the extremely low maintenance requirements, we have enjoyed excellent customer satisfaction. The units are very simple to install, and balance out perfectly for peak load."

YEARS OF SUCCESSFUL OIL FIELD OPERATION UNDER EXTREME WEATHER AND VARYING LOAD CONDITIONS HAVE PROVEN THE ADD-A-PHASE

To Operate 3-Phase From Single Phase Get ADD-A-PHASE

ADD-A-PHASE, ECM-4
Div. System Analyzer Corp., Nokomis, Illinois

Gentlemen: Please send, without obligation, complete details on your ADD-A-PHASE Power Converter.

Name_____ Title_____

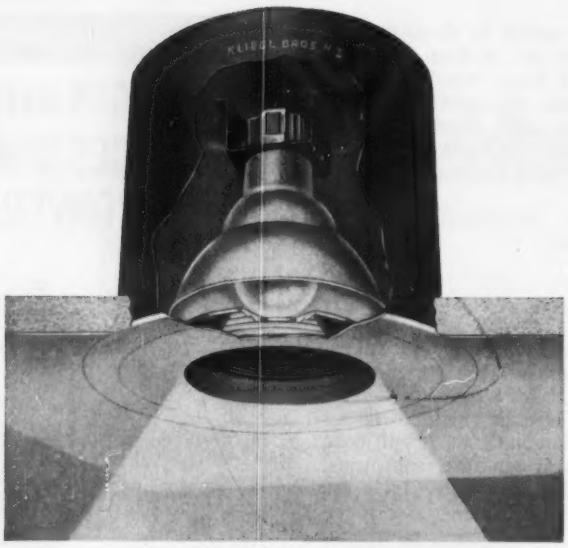
Company_____

Address_____

City_____ Zone_____

State_____

SEE FOR YOURSELF . . . package includes many case histories of the success of the Add-A-Phase . . . years of trouble free use. IF YOU HAVE A SPECIFIC ELECTRIC POWER PROBLEM GIVE US THE DETAILS FOR RECOMMENDATION.



Regressed Lens Downlights with Designed Optics by Kliegl

. . . the Great Name in Lighting!

Designed Optics . . . properly controlled general area illumination from a concealed lens downlight. Using a specially designed hidden lens support cone and a Fresnel Lens with black painted risers, Kliegl Regressed Lens Downlights give a soft illumination without side glare or surface brightness.

Kliegl Regressed Lens Downlights are optically designed to give excellent performance and easy maintenance. A special flush face plate design produces the distinctive "clean look" when installed.

Plan to use Kliegl Regressed Lens Downlights on your next project. For complete information, write for our Architectural Lighting Catalog.

lighting
KLIEGL BROS.
UNIVERSAL ELECTRIC STAGE LIGHTING CO., INC.
321 W. 50th ST., NEW YORK 19, N. Y.
ORIGINATORS AND MANUFACTURERS OF KLIEGLIGHTS

Limit Switch (46)

A heavy-duty, watertight, double-circuit, push-pull limit switch system designed for heavy industrial use. The 9439DW2 limit switch system features heavy-duty eyelets on the end of each push-pull rod for attachment of operating cables. It is for rigging safety devices and is convenient for adjusting travel of hoists and winches. Adjustment is made by two stop collars on operating rod. Contacts of all switches are rated for ac or dc control circuits. Ratings are 600 volts maximum ac or dc, and contacts will normally handle 10 amps 60-cycle ac or 2 amps non-inductive load dc. A ½-in. conduit tap is standard on the 9439DW2. Switch system is double-limit with contacts normally closed.

Atlee Corporation, Monitor Controller Div., 99 Grove St., Rockland, Mass.

Fittings (47)

Two new fittings for large-size entrance cable are available for 125-, 150-, 175- and 200-amp service. The 257 service-cable head features a split insulator and a 60° overhanging cap to prevent blowing rain from entering. Cap design also holds conductors downward, preventing cable from touching cap after installation. The companion RN Hex-Nut connectors for above cable sizes include a neoprene gland and connector is so designed to prevent twisting or distortion of gland when tightened around cable.

M. & W. Electric Mfg. Co., Inc., P. O. Box 87, East Palestine, Ohio

Brake (48)

The new 46,000 Series brake operates on ac and is flange-mounted. Brake is available completely enclosed in a housing with torque ratings of 500, 750, and 1000 lbs ft. The "unitized" construction is retained. Entire operating mechanism is attached to a single plate facilitating disassembly and assembly for maintenance. Need for readjustment to compensate for lining wear can be visually determined from outside the enclosure. Manual release-automatic reset is included. Standard motor-shaft lengths, or through shafts can be accommodated. Floor-mounted models are also available.

Stearns Electric Corp., 120 North Broadway, Milwaukee 2, Wis.

Lighting Unit (49)

New, low-level fluorescent unit, known as "Terrace-Lite," is designed for illumination of entrances, walkways, driveways, patios, pools and around shrubbery. Made of aluminum, the "Terrace-Lite" is available in six colors and three heights—18, 30 and 48 in.

Sterner Industries, Winston, Minn.

Pad-Mounted Gear (50)

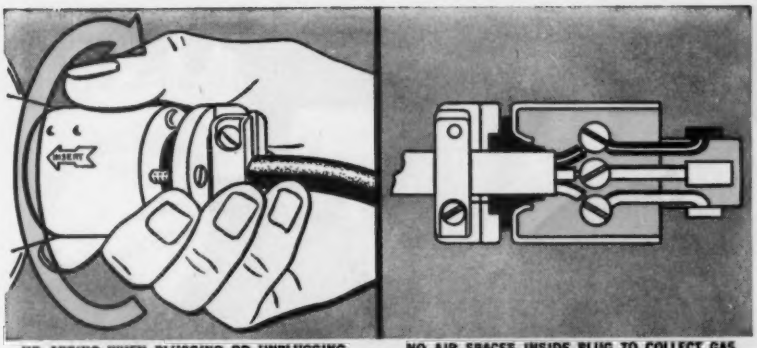
New pad-mounted gear has been introduced for switching, protecting, and isolating residential underground distribution circuits from 2.4 to 14.4 kv. Basic applications are for transformers and for sectionalizing. In either case, fuses and disconnects operate in air with completely visible circuitry. They can interrupt load, magnetizing, or charging currents when operated with Loadbuster, a portable load-break tool. With Loadbuster, the gear will switch up to 400 amps load current at 14.4 kv. Fuses are available up to 200E amps continuous and 17,500 amps, asymmetrical, interrupting.

S&C Electric Company, 4435 North Ravenswood, Chicago 40, Ill.

Power Plants (51)

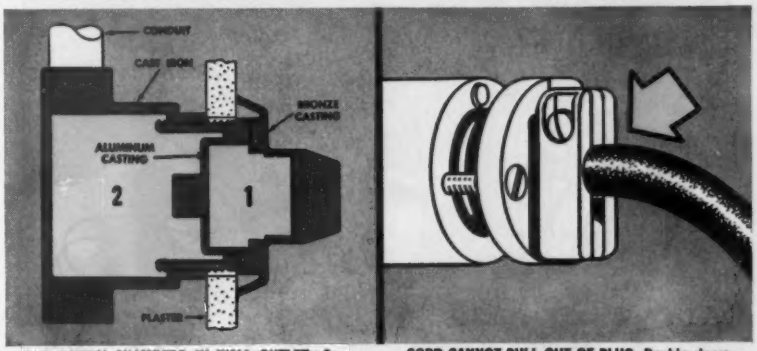
A new line of lightweight Trailite compact ac electric power plants and accessories. They are adaptable to a wide range of usages, are rated from 800 to 3000 watts, and provide instant, ac, 110-volt, 60-cycle emergency power for the home. In case of a disaster, a continuous uninterrupted flow of ac current is ready to keep in operation the residence heating plant, refrigerator and lights. Emergency switchover is accomplished by pulling master switch and plugging in the generating plant to nearest light receptacle.

Thiel Industries, Inc., N. Third and W. Fowler Sts., Milwaukee 3, Wis.



NO ARCING WHEN PLUGGING OR UNPLUGGING. Outlet is electrically "dead" until plug is inserted and rotated 22-25°. Reverse turn disconnects current before plug is removed. Spring pressure and keyed construction prevent accidental disconnection.

NO AIR SPACES INSIDE PLUG TO COLLECT GAS OR MOISTURE. After plug is wired to cord, electrician pours a self-hardening insulating resin into all air spaces. Interior of plug becomes solid, water-tight, vapor-tight mass.



TWO SAFETY CHAMBERS IN WALL OUTLET. Gas-tight chamber No. 1 (bronze and aluminum castings) contains and seals off switching mechanism. Cast iron chamber No. 2 keeps minor internal explosions from spreading to room.

CORD CANNOT PULL OUT OF PLUG. Double-clamping cord-grip relieves strain on plug terminals. And because terminals and wires are completely embedded in insulating resin, connections cannot loosen to cause arcing.

NEW

EXPLOSION-PROOF

RECEPTACLE AND PLUG

FOR CLASS I, GROUP C OR D, ATMOSPHERES

The Hubbellock Explosion-Proof Receptacle and Plug prevent arcing when electrical connections are made or broken in explosive atmospheres. No special wiring is required for installation in new or existing structures.

There are no air spaces in the plug where explosive gases can collect. No current can flow to the receptacle contacts while the plug is being inserted or removed. Switching takes place inside a vapor-sealed safety chamber of heavy bronze and aluminum castings.

Any 20-ampere, 125-volt, 60 cycle A.C. appliance may be operated from the receptacle by substituting the Hubbellock Explosion-Proof plug for the present plug. Appliances equipped with the Explosion-Proof plug will also operate in conventional 3-wire Hubbellock receptacles.

Plug and receptacle are listed by Underwriters' Laboratories and are described by the National Fire Protection Association for use in Class I, Group C or D, explosive atmospheres. They are ideal for hazardous industrial areas and for hospital operating and delivery rooms.

Write now for detailed specifications and prices.

"Hubbellock" is a registered trademark of Harvey Hubbell, Inc.

EXPLOSION PROOF Hubbellock® WIRING DEVICES

HARVEY HUBBELL, INCORPORATED • BRIDGEPORT 2, CONNECTICUT In Canada: Scarborough, Ontario

RIDGID®

65R-TC

RATCHET THREADER

with new True-Centering Workholder

Gives Better Threads Faster 4 Ways!

Here's Why:
One set of dies threads 1", 1¼", 1½" and 2" pipe and conduit . . . no dies to change. • Fast-to-set, True-Centering Workholder centers dies for true threads every time • Easy adjustment for accurate "drip" threads • It's jam-proof . . . automatic kick-out —prevents jamming.

RIDGID 65-RC with Cam-Type Workholder Also Available.

Call your Distributor today. For your convenience, he maintains a complete stock of RIDGID Work-Saver Pipe Tools and parts!

RIDGID

The Ridge Tool Company, Elyria, Ohio, U.S.A.

Catalogs & Bulletins

(52) PUMPING CONTROLLERS. Bulletin GEA-7310, 8 pages, describes line of 220- and 440-volt oil-well pumping controllers for outdoor operation of polyphase motors up to 100 hp. General Electric Co.

(53) POTTING COMPOUND. 4-page Bulletin CDS-280 lists the complete properties of recently developed clear silicone potting compound (LTV-602). General Electric Co., Silicone Products Dept.

(54) HOSPITAL LIGHTING. 20-page catalog contains descriptions of fluorescent and incandescent units for operating rooms, patient's ward, administrative and service areas with suggestions for hospital lighting layouts. Day-Brite Lighting, Inc.

(55) INDUSTRIAL WIRE. Brochure DM-6030 covers specification requirements and allowable current-carrying capacities for Densheath 900. Anaconda Wire and Cable Co.

(56) MANUAL STARTERS for fractional horsepower motors are described in 8-page Booklet 10-B1. Furnas Electric Co.

(57) PRISMATIC FIXTURES. Catalog PB61 illustrates new line of completely weatherproof prismatic wall bracket and ceiling fixtures for all residential, commercial and industrial exteriors. Stonco Electric Products Co.

(58) LIGHTING problems in modern industry are discussed and analyzed in new High-Bay lighting catalog, and solutions suggested in the form of the various mercury-vapor and incandescent lighting fixtures produced. Benjamin Div., Thomas Industries Inc.

(59) THERMAL INSULATIONS for all types of commercial and industrial requirements are described in revised 64-page Catalog IN-244A entitled "Insulation Product Information." Johns-Manville Corp.

(60) TRANSFORMERS. 52-page pocket manual "Transformers Tips," 61X9659, contains general information, operating and maintenance tips and connections for pole-type distribution transformers. Allis-Chalmers Mfg. Co.

(61) SYNCHRONOUS GENERATOR Bulletin 2100-PRD-250 describes line of ac generators in ratings from 3.75 through 62.5 kva. Electric Machinery Mfg. Co.

(62) PUSHBUTTON STATION. New Flexitite all-rubber pushbutton station for oil-tight and heavy-duty service is described in 4-page bulletin. Joy Manufacturing Co., Electrical Products Div.

(63) IMPULSE COUNTER. Bulletin N-310 describes new Series 310 automatic reset impulse counter. Automatic Timing & Controls, Inc.

(64) BANK LIGHTING brochure discusses good lighting, artificial, ceiling, and contrast lighting. Holophane Co., Inc.

(65) COUNTING INSTRUMENTS. 6-page Catalog 608.462 describes and illustrates dustproof and hermetically sealed coin counters, photoelectric equipment. Automation Controls Div., General Controls Co.

(66) TRANSITE TELEPHONE DUCT. 4-page Folder TR-264A gives designers of cable-carrying systems and specifiers of materials complete information on Transite telephone duct. Johns-Manville Corp.

(67) AMPLIDYNES for precise drive control of power outputs up to 100 kw are described in 12-page Booklet GEA-7111. General Electric Co.

(68) CABLE. WESTRIP catalog covers new line of multi-colored ribbon cable. Westwood Cable Corp.

(69) SILICONE insulated wire and cable are described in two 4-page bulletins entitled "Single and Multi-Conductor Cable with Silicone Rubber" and "Wire and Cable Application Case Histories." Boston Insulated Wire and Cable Co.

(70) RADIO EQUIPMENT. Bulletin ECR-870 describes new G-E PACER line of compact, economy two-way radio equipment. General Electric Co., Communications Products Dept.

(71) TWO-WAY RADIO Guide ECR-568A titled "Under the Influence of Radio" informs potential mobile communications users of some important FCC licensing requirements. General Electric Co., Communication Products Dept.

(72) MOTORS. 2-page Bulletin 1465 describes part-winding starting motors. Century Electric Co.

(73) LUMINAIRES. 6-page Booklet SA-8868 describes line of type-SF surface-mounted fluorescent luminaries. Westinghouse Electric Corp., Lighting Div.

(74) POWER PROTECTOR. Bulletin GEA-6527-1, 4-page supplement, illustrates new features that permit safer entrances up to 480 volts ac with Type LB-1 power protectors. General Electric Co.

World's Fastest, Smoothest Hand Reaming

Self-Feeding RIDGID® No. 2-S Spiral Reamer

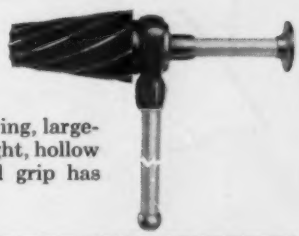
. . . reams pipe, conduit, sheet metal and wood!

Try a RIDGID Spiral Reamer, and you'll quickly feel how it reams its way into pipe, conduit, metal holes or wood without effort. Heat-treated cutting edges give maximum service life. Ratchet-action handle makes work easy in close quarters.

Now Available . . .

RIDGID No. 254 Spiral Reamer

for 2½" to 4" Pipe and Conduit



No more hand filing . . . here's the time-saving, large-size hand reamer you've always needed. Light, hollow construction makes handling easy. Hand grip has large butt plate for body pressure.

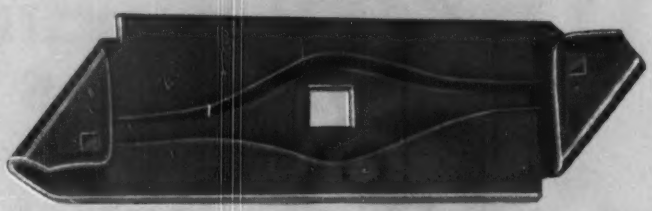
Call your Distributor today. For your convenience, he maintains a complete stock of RIDGID Work-Saver Pipe Tools and parts!

RIDGID

The Ridge Tool Company, Elyria, Ohio, U.S.A.

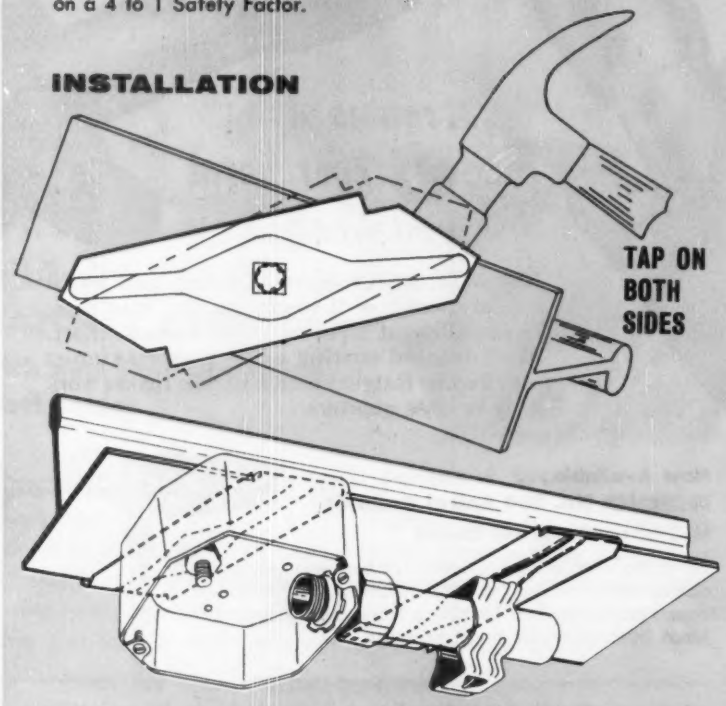
GAT®

TAP-CLIP (4-J-24-38) for suspension of junction boxes, conduit, lighting fixtures, tubing and 2x4's from Bulb Tees.



Strap fits all bulb tees 1½" thru 2⅜" wide. Self-centering bolt. Strap design permits fast and easy installation regardless of the insulation material used. Ceiling material not defaced when applied. Use standard ¼" carriage bolt to desired length (not furnished). Made of spring steel and coated with rust-proof finish. Recommended for static load limits up to and including 150 lbs. per hanger based on a 4 to 1 Safety Factor.

INSTALLATION



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FASTENER Div. ERICO **CADWELD** PRODUCTS, INC.
4070 EAST 61st PLACE • CLEVELAND 3, OHIO

(75) CABLES. Publication C-118 covers development and application of portable cables for surface mining. Anaconda Wire and Cable Co.

(76) MULTI-SPEED MOTORS, both polyphase and single phase, are discussed in 4-page Bulletin 1300. Century Electric Co.

(77) CALCULATOR. Pocket-size graphic calculator provides means of determining megohms-per-pound and cost-per-megohm of enameled 800-ohm nickel-chromium and 815-ohm iron-chromium-aluminum resistor wire. Hoskins Mfg. Co.

(78) FASTENER GUIDE provides data needed to select right fastener for any application. Diamond Expansion Bolt Co., Inc.

(79) PLASTIC ENVELOPES. Bulletin 809 offers descriptive data and prices on protective plastic envelopes for permanent protection of blueprints, charts, diagrams, etc. Seton Name Plate Co., Inc.

(80) PUMP MOTORS. Bulletin 1455 covers close-coupled pump motors, both polyphase and single phase. Century Electric Co.

(81) LOW-VOLTAGE SWITCHGEAR. Publication GED-4269, 6 pages, describes features of advanced load center unit substation with new low-voltage switchgear. General Electric Co.

(82) LIMIT SWITCHES. Bulletin GEA-7312, 12 pages, describes line of limit switches for automatic pilot control. General Electric Co.

(83) GENERATING PLANTS. Entire line of gasoline and diesel driven electric generating plants is listed on catalog sheet. Onan Div., Studebaker-Packard Corp.

(84) SERVICE-ENTRANCE EQUIPMENT. Bulletin 601 is entitled "Facts You Should Know About Service-Entrance Equipment." Pringle Electrical Mfg. Co., Inc.

(85) FLOODLIGHTS. Bulletin 6175c, 16-page revision, tells how to select floodlights. General Electric Co.

(86) SPEED DRIVES. 6-page Bulletin 2900 outlines line of adjustable-speed drives for applications in the ¾ to 2500-hp drive range. Louis Allis Co.

(87) POWER SUPPLIES. 16-page catalog describes standard dc power supplies and test instruments. Opad Electric Co.

(88) SPEED DRIVES. Bulletin GEA-7208, 4 pages, describes new half-wave, fractional-hp electronic adjustable speed drives, employing silicon controlled rectifiers. General Electric Co.

(89) LIGHTING CATALOG No. 116 describes line of incandescent, fluorescent, combination and magnifying lamps. Luxo Lamp Corp.

(90) DIAL TIMER. Bulletin N-309 describes new Series 309 pushbutton automatic reset dial timer. Automatic Timing & Controls, Inc.

(91) WIRE MARKERS. New Perma-Code wire-marker bulletin contains listing of over 400 different miniature wire markers. W. H. Brady Co.

(92) LOW-VOLTAGE DISTRIBUTION. "Buy Log," 92-page catalog, covers low-voltage distribution equipment designed to serve as a condensed buying catalog for products of Distribution Assemblies Dept. and Circuit Protective Devices Dept. General Electric Co.

(93) OUTDOOR LIGHTING Catalog S-61, 8 pages, condenses a general cross-section of complete line of cast-aluminum outdoor floodlights and fixtures. Stonco Electric Products Co.

(94) CONTROL TRANSFORMERS. Catalog 141-B01 describes functions of machine-tool control transformers. Acme Electric Corp.

(95) CONNECTORS. 8-page brochure describes new connectors for aluminum-sheathed, high-frequency Styroflex and Foamflex coaxial cables. Phelps Dodge Copper Products Corp.

(96) OIL FILTER PRESSES and Pyranol purifiers are discussed in 4-page Bulletin GEA-7141. General Electric Co.

(97) STOCK RELAY catalog describes and gives specifications and prices of relays carried in stock. Magnecraft Electric Co.

(98) VERTICAL INDUCTION MOTOR Bulletin 1300-PRD-230 describes line of vertical, squirrel-cage induction motor from 60 to 4000 hp. Electric Machinery Mfg. Co.

(99) RECESSED TROFFERS. "Your Guide to the Latest in Recessed Lighting," 36 pages, includes a complete illustrated description of company's line of recessed troffers. Smoot-Holman Co.

(100) TRANSFORMERS. Bulletin GEA-6108D. 24-page revision, gives information on new Permalex transformer insulation system. General Electric Co.

(101) GEARMOTORS and "Line-O-Drive" coupled speed reducers are described in new 6-page Bulletin MD-1. Howell Electric Motors Co.

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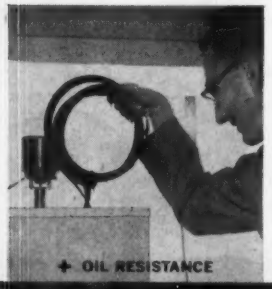
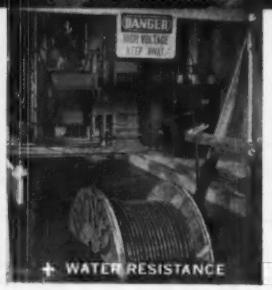
*U. S. PATENT 2867001





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(102) WIRING SYSTEMS. Data Manual Q-63, 56 pages, demonstrates how Robertson Q-Electrical wiring systems for cellular-steel flooring and cellular-strip systems provide unlimited electrical availability. H. H. Robertson Co.

(103) SOLENOIDS. 2-page Bulletin 101 describes Series DS solenoids for automatic equipment requiring a moderate power source. Artisan Electronics Corp.

(104) LIMIT SWITCH. Bulletin GEA-7305, 4 pages, describes new magnet-operated limit switch for highly accurate position detection of objects moving in erratic paths. General Electric Co.

(105) VINYL LOUVERS. Factual report of independent tests made of "Circlgrid" vinyl louvers for luminous ceilings is described in guide. Cirvac Plastics, Div. of Wilson Research Corp.

(106) MERCURY-VAPOR pole-top assemblies using reflector lamps are described in four-page folder. Shalda Mfg. Co., Inc.

(107) TRANSFORMERS. GEA-7108, 8 pages, describes process of rebuilding old distribution transformers. General Electric Co.

(108) SOLDERING. Revised instruction manual "Soldering Simplified" is devoted to teaching the fundamentals for obtaining perfect soldering results in a step-by-step manner. Kester Solder Co.

(109) LIGHTING DESIGN Booklet VE-900 covers lighting terms, formulas and important design factors. Sylvania Lighting Fixtures

(110) FLUORESCENT FIXTURE Catalog V-602A covers line of commercial and industrial lighting fixtures, recessed shallow troffers and air-handling troffers. Sylvania Lighting Fixtures

(111) DRIVE SYSTEMS, timing devices, variable-speed controls, speed reducers and electric motors are described in new catalog. Minarik Electric Co.

(112) PHOTOELECTRIC CONTROLS. 80-page case history handbook details how Infrabeam photoelectric controls solved 40 typical operational problems in materials handling, equipment and personnel protection. Electronics Div., Cramer Controls Corp.

(113) BUILDING PRODUCTS and appliances are described in new catalog for 1961. Berns Air King Corp.

(114) OUTDOOR APPLICATIONS for leased lighting are described in 2-page Booklet SA-8866. Westinghouse Electric Corp., Lighting Div.

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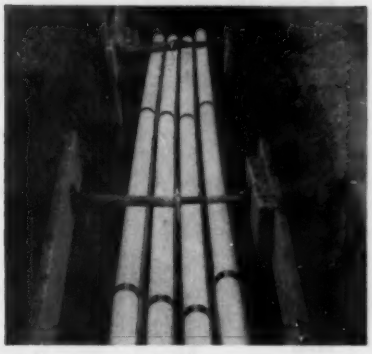

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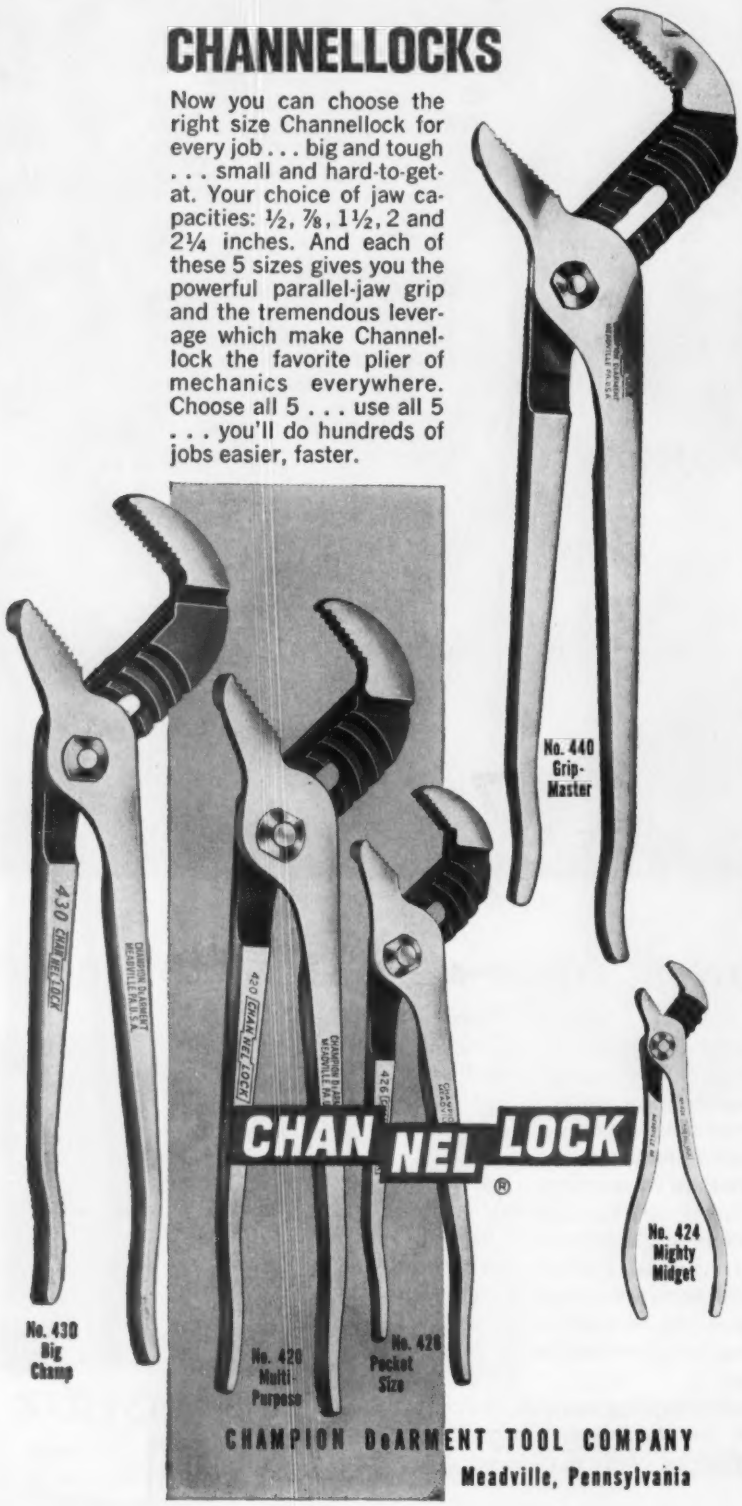

CHAMPION DeARMENT TOOL COMPANY
Meadville, Pennsylvania

BETTER ELECTRICAL DIAGRAMS

[FROM PAGE 111]

easily accessible runs, the height of each run must also be indicated. When power and control conduit-runs are in multiple, identify them to avoid the possibility of confusion. This can be done by dotting the outlines of control runs and "solid-lining" power runs.

Wiring diagrams should show all wire connections and actual location of every wire as it connects to each equipment. The electrician relies heavily on this drawing when making his wiring runs and final connections. We start by laying-out on the drawing, all equipment as it is to be installed in the field. All sub-drawings of individual equipment are planned, such as motor-control centers, control panels, terminal boxes, etc. Next, the actual wire-runs and connections are shown. When both control and power wiring must appear on one drawing, show control wiring "light" and power wiring "dark."

And remember, this is the electrician's "working" drawing. Don't let him get confused now. Keep your lines well spaced; "oversize" the drawing if necessary; include plenty of notes and check each component wiring to be sure there can be no mistake. You'll be more than satisfied with your efforts when you see a complex job installed smoothly and rapidly.

Elementary Diagram

Fig. 3 shows a portion of an ordinary elementary diagram. This drawing tells how the circuit works, which path the current takes in causing the circuit to work, and the general scheme of things from the standpoint of electrical action. Although it has little use during estimating or installation, the schematic is a powerful tool for designing, checking and troubleshooting. Whenever difficulty arises, the electrical foreman uses this drawing to find trouble spots quickly.

To help the electrician troubleshoot even more quickly, the schematic is redrawn as shown in Fig. 4. Here we have indicated location of components and wiring. For example, note that it is evident that PB1 is in panel B while coil 1M is in motor control center C. Looking back at Fig. 3, note that location of components is not shown—a definite disadvantage.

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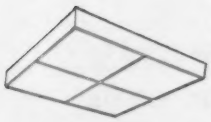

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COMPACT SIZE
Note how the Pyle-Star-Line plug on the right is more compact than the conventional plug on the left.

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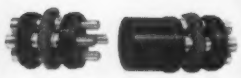

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Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

AC Electromagnets

QUESTION D39—The polarity of an ordinary electromagnet changes with the direction of current flow. If direct current is applied to the coil, and if the flow direction of this current is allowed to remain fixed, there will be no change in polarity. Therefore, the magnet in holding the plunger of a solenoid or clapper of a contactor would exert a constant, uninterrupted pull on the plunger or solenoid. This is understandable. However, in alternating current, since the direction of current flow reverses with each cycle, it would seem that the change in current flow would produce a series of attracting and repelling forces that would neutralize each other, thus making the forces on the plunger ineffective. I am aware that shading coils are used to offset the conditions produced by the zero voltage effect of ac current; but what is done in the winding of an ac magnet coil to maintain the pulling force always in the same direction during changes in the alternating current flow direction. This has always puzzled me. In addition to your answer, I would appreciate your giving me the name of a book treating on this subject.—C.H.M.

ANSWER TO D39—In any magnet the force on the clapper or plunger is a function of the square of the flux density and the size and shape of the air-gap and pole faces. In a dc magnet this flux density (at any air-gap) is constant and, consequently, a force developing as a result of this flux (and its associated air-gap) would also be constant. The force developed, however, is independent of the direction of the flux.

In an ac magnet applied to a sinusoid voltage, the flux will be sinusoid. The flux density (B) in the air-gap will also be sinusoid and its instantaneous value will be Bm Sin WT. in a conventional "C"-shaped clapper-type magnet, instantaneous force equals Bm Sin $WT^2/72$ lb. per sq. in.

If this instantaneous force is plotted, it can be seen that the instantaneous force varies from zero to a maximum value twice each cycle.

An ac magnet, without shading coils in the closed position, will vibrate and chatter because the instantaneous force falls to zero each half cycle. It is not because of any magnetic repelling force. The repelling force actually is the contact spring against which the magnet is pulling.

A shading coil is added at each pole face to produce a flux which is approximately 90 degrees out of phase with the flux produced by the magnet coil. This second flux then prevents the total flux between the pole faces from falling to zero and keeps it to a value which will keep the pole faces in the closed position at all times that the magnet coil is energized.

A good reference is "Electromagnetic Devices" by Herbert C. Roters, published by John Wiley & Sons. See pages 464-480 for a good discussion of shading coils.—H.J.H.

ANSWER TO D39—In the case of the dc solenoid it makes no difference as to the polarity of the connections unless it be polarized, then proper poling is essential. DC solenoids are designed to operate on dc and ac solenoids on ac.

In the former, the shell and core are of solid magnetic material while in the latter it is laminated soft iron. The winding of the ac is comparatively low ohmic resistance but of high impedance. If a comparable dc voltage was impressed on the solenoid it would burn up.

Both operate on the same principle of magnetomotive force set up in the magnetic field of the device. In the ac solenoid the action and reaction is quite different for the ac. The reason why there is no "zero" effect is due partly to the hysteresis curve. The flux does not fall in a straight line as with an air-core inductance, but lags behind with some minor residual magnetism, which requires current and time to reduce to zero. The time required for one cycle, that is zero to maximum positive of the wave, then to zero to maximum negative, then to zero, is 1/4F or .004166 seconds. With the shading coil this becomes approximately 1/8F or .00208 seconds.

In the ac solenoid there is placed in part of the pole face a single turn of low-resistance copper, the main function of which is to prevent the ac hum. This single turn causes the flux in part of the main pole face enclosed by the turn to lag behind the flux produced in the other part of the pole face.

Consider an alternating current flowing in the main winding which induces a flux and magnetomotive force in the pole face. This flux sets up a voltage and current in the shading coil which opposes the flux developed by the main winding differing in phase of about 90° behind; hence for an instant of the cycle, the main flux is concentrated in the unshaded portion of the pole face. When the flux due to the main winding is at the maximum value, the current in the shading coil is zero and the main flux is distributed over the entire pole face.

As this current and flux decrease, the current and flux are reversing in the shading coil setting up a force in opposition to the decreasing flux of the main coil.

The net result of these two forces acting alternately throughout the cycle reduces the hum or chattering at the pole face. The shading coil does not contribute a great amount to the tractive effort of the solenoid as it will operate without the shading coil but will hum. To nullify the effect of the shading coil, place another shading coil on the armature face. The solenoid will operate and will hum.

For books on the subject it is suggested that McGraw-Hill Book Co. or other technical book publishers be consulted.—F.A.G.

Proximity Switch

QUESTION E39—What is a proximity switch? How does it work and where is it used?—R.C.

ANSWER TO E39—A proximity switch, as the name implies, is a switch, or more properly a relay, whose operation or on-off condition is actuated by the presence or closeness of some object.

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available in eight sizes from 4⅝" x 4⅝" x 4¼" to 11" x 12" x 8¼". Choice of dome covers in four heights to facilitate heavy splicing or mounting terminal blocks. Also available with flat blank covers or lens covers for instrument mounting. Lens is heavy shock proof, stressed glass, as strong as the casting.

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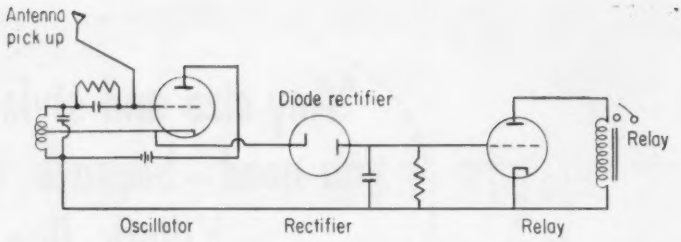


In its most common form it could be called a capacity-operated relay. Above is a circuit diagram of a common capacity-operated relay.

Note the R-C filter network in series with the grid of the oscillator tube. If the value of the capacitance in this grid circuit should change, the amplitude of the oscillations will change. Now if an object, say a human hand should approach the antenna, the grid circuit capacitance against ground will change, thus altering the amplitude of the oscillations. Now, if we take a portion of the oscillating voltage, rectify it and apply it to the grid of a tube controlling a relay, we have a relay controlled by the amplitude, or voltage of the oscillating or alternating current in the oscillator circuit.

This device can be so sensitively designed that should a hand approach within four feet of the antenna, the relay will close. The circuit and refinements of it may be used as a burglar alarm, as a counter of objects passing by, and for a variety of other purposes.—F.W.G.

ANSWER TO E39—A proximity switch or control is the simplest type of the sensing controls in industrial automation. Its basic operating principle is completely based on electronic-wise. It is capable of sensing the presence of any type of conducting substances and liquid.

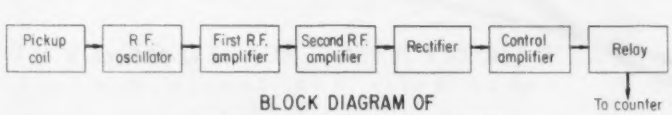
Normally, a proximity switch contains five or six stages as shown in the accompanying block diagram. The sensing coil or pickup coil is the tank circuit of a common type radio frequency oscillator. The rf signal from the oscillator is fed to the two rf amplifiers and rectifier. The output voltage of the rectifier is negative with respect to ground, thus it is used as a negative control bias for the control amplifier. A relay is in the plate circuit of the control amplifier, which is used for counting purposes.

The control amplifier is normally at cut-off state due to the large bias which is supplied by the rf oscillator, thus leaving the relay deenergized. If a conducting material is brought close to the pickup coil, the oscillation is getting weaker and finally stops because it is due to the fact that the pickup coil energy is absorbed by the conducting material and lowers its "Q." When the oscillator stops oscillation, the negative bias is removed from the control amplifier. This permits the control amplifier to conduct and operate the relay which operates a digital counter to give a count. The control amplifier keeps on operating until the conducting material is removed. Then the cycle is completed.

The applications of proximity control are very broad. It can be used to inspect packages, to check bottles, and to sense the position of a piece of work in an automatic machine to control the sequence of machining operations.—S.Y.

ANSWER TO E39—A proximity switch may be described as a capacity-sensitive relay. In a common design, the proximity switch contains a radio-frequency oscillator, a power supply, a sensing antenna and a relay which operates on a current differential of several milliamperes. The range of operation may vary from direct contact to a distance of 100 ft from the sensing antenna.

The principle of operation depends upon the phenomenon of resonance in a radio-frequency oscillator. When an oscillator is tuned to resonance or near resonance, small variations in the capacitance across the tank circuit will produce sudden well-defined changes in the plate current. A relay coil, connected in series with



BLOCK DIAGRAM OF
A TYPICAL PROXIMITY SWITCH SYSTEM

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62nd YEAR — APRIL 1961

STORES NEED OUTLETS A-PLENTY ... FIRST PAGE
CODE COMMENTS ... FIRST PAGE
EDITORIAL ... SECOND PAGE
PRODUCT OF THE MONTH ... SECOND PAGE
QUIZ CORNER ... THIRD PAGE
MEETINGS AHEAD ... THIRD PAGE
PERSONNEL NOTES ... THIRD PAGE
COUPON FOR FREE ITEMS ... THIRD PAGE
ENGINEERED SPECIALS ... FOURTH PAGE
USEFUL LITERATURE ... FOURTH PAGE
PRACTICAL TIPS ... FOURTH PAGE

Modern Store Efficiency Needs Plenty of Outlets

Four examples show how contractor-installed multi-outlet systems helped meet the demands for conveniently located outlets required by modern selling techniques

Merchandising efficiency in modern stores requires the use of large numbers of outlets for proper illumination, display, packaging and many other functions which have become routine.

More and more, electrical engineers, contractors and maintenance men are turning to multi-outlet systems to answer the requirements of modern business practice.

When planning their display of television sets, Hartford's largest department store took into consideration the fact that the walls were movable partitions and that it was

PLUGMOLD strip provided each TV set with its own outlet in this department store display. If partitions are moved, a minimum of electrical work is required.

Code Comments

Partitions and Surface Raceways

Q. *May Wiremold be run through partitions?*

A. Section 352-5 of Article 352 of the National Electrical Code reads, "Except in multi-outlet assemblies, raceways may be extended through dry walls, dry partitions and dry floors, if in unbroken lengths where passing through."

Section 353-3 of Article 353 reads, "Metal (underlining ours) multi-outlet assembly may be extended through (not run within) dry partitions, providing arrangements are made for removing the cap or cover on all exposed portions and no outlet falls within the partitions."

Outlets in Multi-Outlet Systems

Q. *What are the requirements relative to the number of outlets in multi-outlet assemblies?*

A. Section 220-2(c), Article 220, reads: ". . . in locations where a number of appliances are likely to be used simultaneously . . . each one foot or fraction thereof shall be considered as an outlet of not less than 1½ amperes. The requirements of this Section are not applicable to dwellings or the guest rooms of hotels."

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Editorial

Ample Amps Are Not Enough

All alert elements in the electrical industry make sure their customers are provided with ample amps. Those elements which are foresighted, as well as awake to current needs, take the next logical step: they make sure their customers can use the power *conveniently.*

They make certain that outlets are placed wherever they may ever be needed. They are not like the plumber who hooked into a big main and thoroughly piped the house, then forgot to install faucets.

It's as simple as that — and it's even simpler for all concerned when a multi-outlet system (Plugmold, please!) is the means adopted for providing ample outlets for ample amps.

Product of the Month

Single Offset Connector Available for WIREMOLD 2100 and 2600

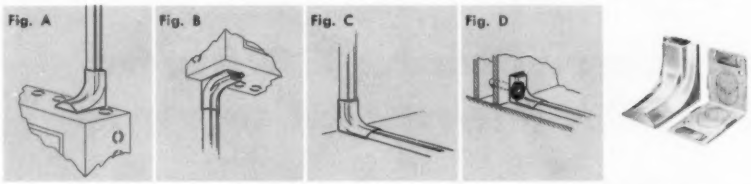
Designed to be used in four ways, the Wiremold 2186 Adjustable Offset Connector is equally at home with Wiremold 2100 or with 2600 Pancake overfloor raceway.

This new fitting can be used as an adjustable offset connector from panel box to 2100 (Fig. A); in the same manner with 2600 (Fig. B); as an internal elbow for 2600 from wall to floor (Fig. C); and as a combination connector for through-partition feeding of 2600 (Fig. D).

The 2186 connector accommodates the maximum wire capacities of either 2100 or 2600. Use of the fitting eliminates offsetting the raceways in making connections with surface type panel boxes.

The base has ¾-in. and 1-in. concentric KO's with the 1-in. KO elongated so that adjustment from surface to center of the bushing is from 1-in. to 1⅝-in.

Removal of twistouts for either 2100 or 2600 is simple and quick.



desirable to have each set plugged-in to an outlet of its own.

Accordingly, the maintenance department chose runs of Plugmold 2000 with outlets 30-in. on centers. If it becomes necessary to move a partition, a minimum of electrical work is required.

Approximately 500 ft. of Plugmold 3000 was used in the Philip Little Studios' display of fixtures.

Mounted flush with the suspended fiber glass tile ceiling, the raceway accommodates 150 light switches, one for each fixture on display. This permits the salesman to control each fixture individually.

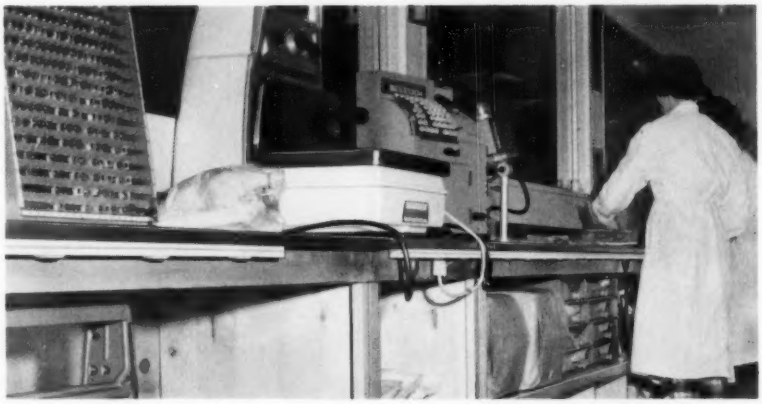
For hanging each fixture, the contractor used a 3046H fixture and drop cord cover with the hole enlarged to 2 in. in diameter. This provided plenty of room for attaching the fixture stud which is mounted in the base of the raceway.

For display of wall brackets, the contractor installed runs of prewired sections of Plugmold 2000 along the back of 12 hinged wooden panels. Each 3-ft. run provides six outlets on 6-in. centers into which the individual wall brackets are plugged so that they can be shown separately to the customer. In addition, runs of Plugmold 2000 and 2100 are used for displays of floor and table lamps.

Luncheonette counters provide an ideal place for the contractor to sell Plugmold. Because of the growing use of electrical devices, the need for plenty of conveniently located receptacles is great. Typical of this type of installation is the one at the Baltimore Drug Store where a run of Plugmold 2000 with grounding type outlets is located along the wall of the food service area, permitting the use of many appliances without the need to unplug one to find room for another.

One of New England's largest chain of supermarkets, First National Stores, selected Plugmold 2000 for use under the edge of meat wrapping benches. The outlets, on 6-in. centers, are placed face down so that the plugs for the sealing irons are out of the way and the girls cannot accidentally knock out the plugs. A similar set-up, with outlets on 18-in. centers is provided for the produce wrapping table.

When the contractor takes the opportunity to install multi-outlets, he provides a double service: he assures his customer of an installation that is convenient and flexible and he assures himself against angry future complaints that he failed to advise the user on the best way to get the outlets he needs.



MEAT WRAPPING benches in this supermarket use multi-outlet strip with outlets placed face down for efficiency and convenience of girls working hot sealing irons.

WIREMOLD®

Advertisement

Quiz Corner

Q. *How do I provide a crossover for power and telephone lines on the floor?*

A. By using a 2642D Junction Box and inserting a section of 1500R Reinforcing Member. The 1500R covers the telephone wires and permits power wires to lie flat over the 1500R.

Q. *What is the KO location in the base of Plugmold Wired Sections?*

A. The KO pattern varies, depending upon the length of the Plugmold strip. However, the pattern is definite and can be found on Page 92 of Catalog and Wiring Guide No. 22. (Check the coupon at bottom of this page.)

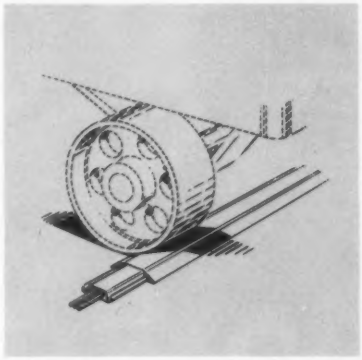
Q. *Is blank fill-in cover available in 2000 and 2200 Plugmold?*

A. Yes, standard lengths, which can be cut to fit, are available in both sizes.

Q. *How do I replace a receptacle in 2000 Plugmold?*

A. If it is necessary, replacement receptacles 2027G, 2043D, and 2043S are available with 6" leads. Just remove the cover section, cut out old receptacle, splice in the replacement, snap the receptacle in the holecut, and snap the cover back on. The W-30 Wire Connector makes the job even easier.

Q. *I have 1500 Pancake Overfloor Raceway on the floor of my plant where heavily loaded trucks with steel wheels may run over it. Is there a precautionary measure I can take to strengthen the raceway further?*



A. Yes, No. 1500R Reinforcing Member is available for just this purpose.

Q. *Where can I find a list of typical devices and the Wiremold boxes that will accept them?*

A. On Page 46 of Wiremold Catalog and Wiring Guide No. 22.

Q. *What is the maximum number of conductors I can use in a 5748 Box?*

A. 12 No. 14; 10 No. 12; 9 No. 10; 8 No. 8. On page 144 of Wiremold Catalog and Wiring Guide No. 22 there is a listing of 41 Wiremold fittings with the maximum number of conductors permitted.

WIREMOLD ■ HARTFORD 10, CONN.

Gentlemen: Please send me checked items

NAME

COMPANY

ADDRESS

☐ Wiring Guide (Catalog 22)

☐ Plugmold 2000 folder

☐ Plugmold 2200 folder

☐ Plugmold 3000 folder

☐ Tele-Power Duct Systems folder

E1-4

Personnel Notes

Honors at the Elizabeth exposition will be shared by Phil McGovern, Frank Mahan, and Allan Bradbury.

Terrell Philen of Biglin Associates will represent Wiremold at the Birmingham show.

Bob Bennett is slated to be on hand at the Commonwealth Armory for the Boston show, as are Bill Parks and Sam Page.

Ambrose Massey and John Leddin will be at Chicago.

Show dates and locations are listed under "Meetings Ahead."

Phil McGovern

Frank Mahan

Allan Bradbury

Terrell Philen

Bob Bennett

Bill Parks

Sam Page

Ambrose Massey

Meetings Ahead

Electrical Industrial Exposition (Essex Electrical League) — Armory, Elizabeth, N.J., April 11, 12, & 13.

Alabama Electrical and Electronics Exposition — Birmingham City Auditorium, April 17, 18, & 19.

Electrical Trade Show (E.M.R.A.) — Commonwealth Armory, Boston, Massachusetts, April 18, 19, & 20.

Midwest Electrical Industry & Lighting Exposition — McCormick Place, Chicago, May 2, 3, & 4.

WIREMOLD®

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Engineered Specials

Highly mobile work bench has outlets, fuse

PROBLEM:

To provide electrical outlets on a work bench where electronic testing equipment or small, portable machine tools are used. Grounding outlets and circuit protection are required. The bench must be easy to move from room to room or to ship by air.

SOLUTION:

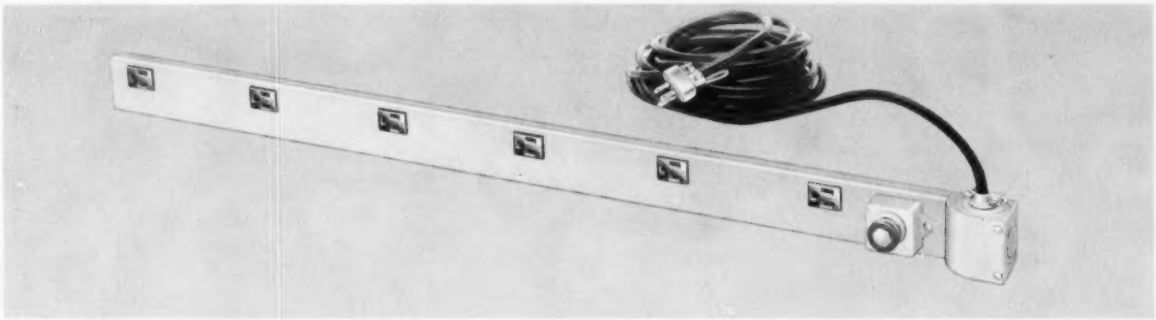
The bench, with wheels, folds into a neat, square package for shipping. A special Plugmold 2200 multi-outlet system was installed, with a built-in fuse box and cord and plug cap.

DISCUSSION:

Original design specified Plugmold 2000 with separate fuse box. Wiremold engineers proposed using the larger 2200 raceway to permit mounting a fuse box in the raceway. A special hole was cut in the raceway cover for a 15-amp fuse.

The 38⅜-in. unit (see illustration) has six grounding outlets spaced 6-in. on centers. Standard Snapicoil pre-wired outlets were used. Connection of the wiring harness to the plug-cap cord is housed in a standard Wiremold 2210D entrance end fitting.

Wiremold engineers welcome the opportunity to work on such special adaptations of its standard products.



USEFUL LITERATURE

Check coupon on preceding page for copies of listed items.

Tele-Power Duct Systems

A 4-page folder describes Tele-Power systems — a pair of parallel Wiremold raceways, one for telephone, signal and inter-office communications wiring; the other a multi-outlet system for power and light wiring.

Catalog and Wiring Guide No. 22

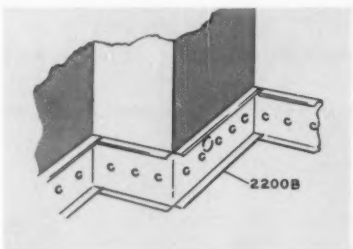
Pocket-size, 152-page guide gives complete details on Wiremold raceways, fittings, lighting equipment and tools. The book contains a section on the NEC as it affects Wiremold products, including a table showing capacities of all Wiremold boxes and tables giving revised UL-listed capacities for Plugmold 2100 and 3000.

Practical Tips

Compound bends in Plugmold 2200 easily made

Bending the base of Plugmold 2200 around wall offsets can be neatly and effectively accomplished with a few simple saw cuts.

Forming an external corner only requires a single 90° cut at top and bottom of raceway (see illustration). For an internal corner, two 90° cuts, spaced 7/16″ on centers, are necessary. With pliers, remove the 7/16″ slug from top and bottom of raceway. When the internal bend is made, it is not only neat, but also stronger, because the base is maintained as a single, continuous piece around the entire offset.



A Wiremold 610A Miter Box can further simplify the job. It is designed specifically to hold the 2200 raceway, and has two 90° slots spaced 7/16″ on centers, assuring accurate cuts for internal corners.

Other techniques are described in Wiremold Wiring Guide; check coupon on preceding page for a copy.

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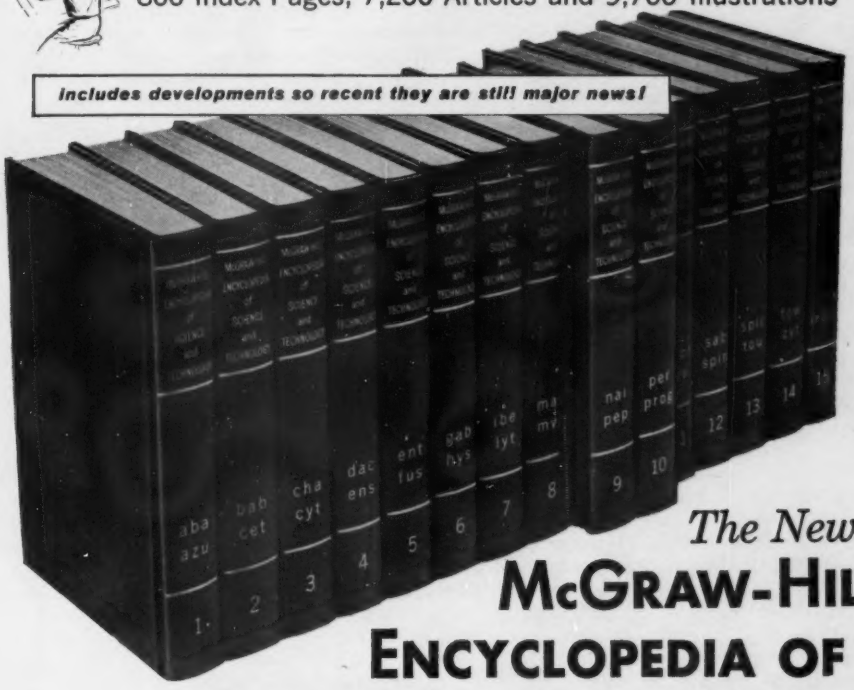

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the plate circuit, can be adjusted to open and close in accordance with plate-current variations. The plate current is minimum when the oscillator is tuned to resonance and rises to a maximum at some frequency above or below resonance.

In a typical oscillator, the frequency is mainly determined by a tank circuit consisting of a fixed inductance and a variable capacitance connected in parallel. The variable capacitance tunes the oscillator through a wide range of frequencies. The sensing antenna, which is closely coupled to the tank circuit, alters the frequency only within a narrow range. A small increase in capacitance occurs when an object approaches the antenna.

For standby operations, the relay is energized by a relatively high plate current and the contacts are open. Assume that the oscillator is initially adjusted to a frequency that is slightly above resonance. As an object approaches the antenna, the capacitance across the tank circuit increases slightly, causing the plate current flowing in the relay coil to drop. When the current is reduced sufficiently, the relay "drops out" and the contacts close. Withdrawing the object from the antenna reverses the conditions and causes the contacts to reopen.

The many applications of the proximity switch include the following: operation of a drinking fountain; a burglar alarm; control of interior lighting; a counting or dividing device; a go or no-go gauge; an automatic door opener; an automatic camera shutter for photography of wild animals and birds; an aircraft altimeter; a device for leveling an elevator at each stop; and a safety switch for machinery. A kind of proximity switch called a proximity fuse was used in artillery shells during World War II.—K.C.

Magnetic Converter

QUESTION F39—We have heard that there is an apparatus for converting power to a double frequency, say 120 cps from 60 cps supply. This apparatus is not a rotary equipment or motor-generator set, neither a mercury nor other type electronic converter, but is an entirely magnetic converter.

Would like information on the principle of the apparatus, range of voltages and capacities available, and if possible, names of manufacturers.—F.G.

ANSWER TO F39—Your mention of "an entirely magnetic converter" probably has reference to a magnetic frequency multiplier, which was originally designed as a power supply for high-frequency operation of fluorescent lamps some years ago. In fact, a very informative article on the subject appeared in the November, 1954 issue (page 89) of *Electrical Construction and Maintenance*. The title of the article was "Magnetic Frequency Multipliers for High Frequency Operation of Fluorescent Lamps" and was written by two experts in the field. Discussed in this article are the theory and circuit for the magnetic frequency multiplier; construction of units; and performance ratings. Units described pertain to the conversion of 60 cps to 360 cps. Voltage is changed from 480 volts to 700 volts, and individual units are rated at 5 kw. Additional information on magnetic frequency multipliers can be obtained from the General Electric Co., Lamp Division, Nela Park, Cleveland, Ohio, and General Electric Co., Specialty Transformer Dept., Fort Wayne, Ind.

Another form of static converter under present consideration is a semi-conductor converter, which many engineers hope will replace rotator converters in time.

However, it is important to note that, at present, the most efficient and economical method of converting frequency for power applications is by means of rotating converters. Therefore, if F.G. is looking for static converters to replace rotator converts (for power loads), he may have to wait a few years.—J.W.

Capacitor Locations

QUESTION G39—We are in the throes of making a power factor correction on our power distribution system. The need was determined by a preliminary investigation. Our original one problem (need for capacitors) has expanded into four problems (where to locate capacitors).

With our power distribution system, we have four places that we can locate the capacitors: 1. *at the load;* 2. *at the busduct feeding a group of individual loads;* 3. *on the secondary side of our transformers (480 volts);* 4, *on the primary side of our transformers (4160 volts). Where is the best location for the capacitors?—J.A.M.*

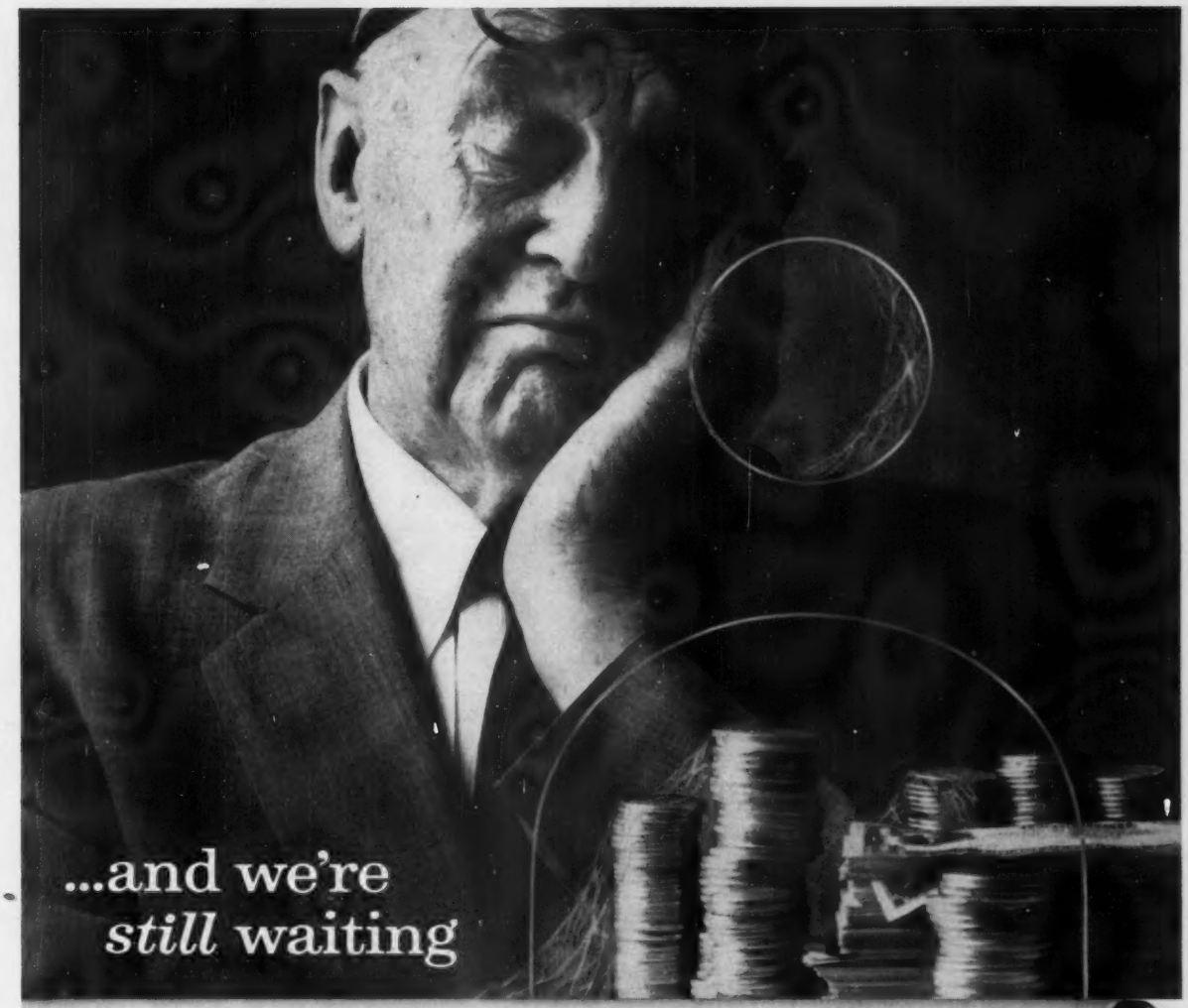
ANSWER TO G39—All of the published literature covering capacitors indicates that the best location for capacitors is at the load. It is here that the kilovars are produced and this is the best location for correction or reduction of kvars.

The ideal arrangement is a capacitor, properly sized, at each motor. This provides automatic correction as the total load varies, allows the maximum utilization of the distribution system copper, and keeps line voltage-drops (with its associated losses) to a minimum.

There are two schools of thought concerning the exact point of connection for capacitors when located at each motor. The capacitors can be connected across the motor leads; i.e., on the load side of the starter. Under these conditions the current through the starter is less than that current taken by the motor without the capacitors. Consequently, the heaters in the overload relays must be sized accordingly. There is manufacturer's literature available which tabulates this percentage reduction of motor current.

Of course, locating capacitors at each motor is the best arrangement, and like all best arrangements, it is the most expensive. An economical installation would take into consideration size, location and operating time (diversity factor) of each motor. For an example, if only 50% of a group of small motors in the same area are operated at one time, a centrally located capacitor, sized for 50% of the total load, could be installed. Here a disconnect and protective device should be included and, of course, the capacitor is switched on and off manually or left on continually. The automatic feature is gone.

Locating capacitors at the transformer, either primary or secondary, would be a most inefficient location. Here the only function they would perform would be power-factor correction, as far as power costs are concerned with the local utility. The distribution system on the load side remains exactly the same and nothing has been contributed by the capacitors to improve this system. Keep in mind that utilities offer a bonus for good power factor, because this good power factor allows them to get maximum power (kilowatts) from their distribution system. The distribution system within the plant should be treated the same. This is done by locating the capacitors as close to the load as is economically possible.—H.J.H.



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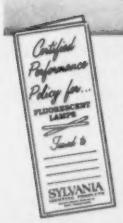

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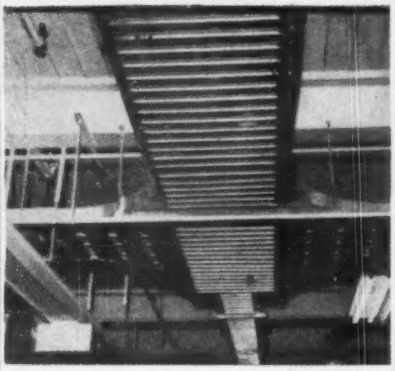

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ANSWER TO G39—Capacitors are capable of performing four functions:

1) Decrease your power bill by reducing the kva demand of the plant and thereby reduce your utility's demand charge, assuming your plant is billed on a demand charge with a "power factor clause."

2) Unload your feeders and branch circuits and effectively "increase" their capacity by reducing the kva load on these circuits.

3) Unload your transformers and effectively "increase" their capacity by reducing the kva load on the transformers.

4) Improve voltage by reducing the secondary load current and, consequently, the voltage drop in transformers, feeders and branch circuits.

While all the above advantages *may* be obtained with capacitors, the installed location of the capacitors will determine which advantages *will* be realized.

Ideally, and in order to obtain all four advantages, the capacitors should be installed at the load, such as at each individual motor. In this way, the capacitors may be installed on the load side of the controller and switched with the motor. Care should be taken, however, to size the capacitors according to manufacturer's recommendations, depending on the horsepower rating and speed of the individual motor in order to avoid overvoltage from self-excitation. Also, the size of the heaters of the overload relays in the motor controllers should be reduced in order to compensate for the reduction in motor current and still provide running protection.

The least desirable location for the capacitors is on the primary side of your transformers (and on the load side of your utility's metering equipment). The only advantage realized here will be to reduce the utility's demand charge. The other capacitor locations proposed by you serve with increasing effectiveness as you approach the ultimate load location.

As can be expected, the most desirable location will be the most expensive installation on a first cost basis, since it will probably involve many individual capacitor installations with the resulting high cost of labor. Also, you can expect to pay about $8.00 per kvar for capacitors rated at 480 volts. On the other hand, your cheapest installation will be on the primary side of the transformers, possibly pole-mounted capacitors in one or two locations, with a relatively low labor cost. Capacitors rated at 4160 volts will cost you approximately $2.50 per kvar.

If you are interested only in reducing your utility demand charge and your transformers and feeders are comparatively lightly loaded with no voltage problems, I would suggest the primary installation. If, however, your transformer and feeder loads are approaching rated capacity and reduction of the kva load can postpone transformer or feeder replacement, it would benefit you to install the capacitors at the load.

Actually, it all boils down to this: what are you trying to accomplish and how much is it worth to you?—J.J.M.

Can You Answer These QUESTIONS?

QUESTION P39 — On a military camp design we ran into the problem of illuminating, with an evenly distributed 35 fc, a highly reflective surface—a 15-ft-high swinging map, covered with Plexiglas. The map, located in full width along a wall in a room of 400 sq ft, swings into two parts, 90 degrees away from the wall on two curved rails, which are hanging 9 in. below the concrete ceiling. With fixtures recessed in the concrete ruled out, what type of illumination could be considered as the best solution?—L.H.H.

QUESTION Q39 — Is the ampere rating of a NEC or current-limiting fuse altered if the fuse is used in a circuit whose voltage is appreciably above or below the voltage rating of the fuse, and if so, why?—R.E.B.

QUESTION R39—On a dual-voltage Y-motor, 220/240 volts, 3-phase, 60 cycles, where all the identification has been obliterated on all nine leads, is there a quick method of re-identifying them properly and re-connecting them?

We can get three pairs that read through: such as No. 1 and No. 4; No. 2 and No. 5; No. 3 and No. 6. But how do we find which are numbers 1-2-3, and how do we find numbers 7-8-9?—H.R.B.

PLEASE SEND IN YOUR ANSWERS BY MAY 15

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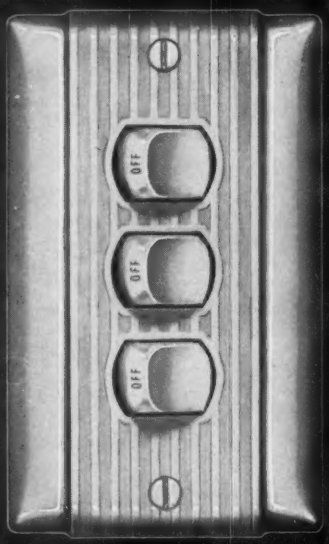

All switches are *NOT* alike. That's why it will pay you to select a switch from a manufacturer whose dependability you already know. The same engineering skill that goes into making your Rocker-Glo switches, also goes into rugged, heavy duty Super AC. For heavy duty switches or residential, you'll always do better with *Precision Switches* by P & S.

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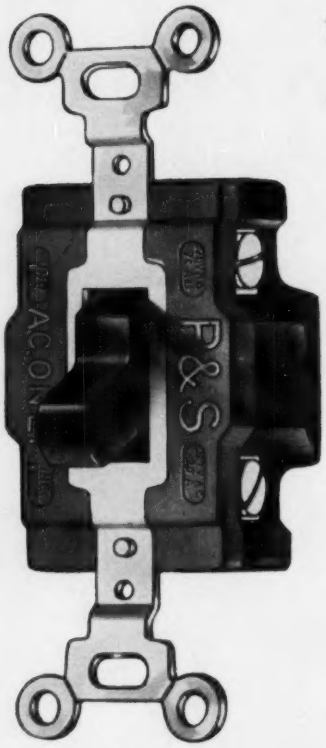

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Questions on the Code

Answered by:

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*

B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*

R. E. WARD, *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

Condensation

Q. *We started a Maintenance of Service Program and have uncovered a situation that I believe needs investigating, and one we would like to call to your attention.*

We have found in several instances where a house has electric heat, with the switchgear located in a heated portion of the house, condensation taking place in the conduit between the switch equipment and the meter.

In one case a meter burned up due to the fact it contained a considerable amount of water. We have found three cases with a cup full or more of water. On further examinations we have found the conduit from the meter base to the switchgear equipment containing water.

In observing some of the well-insulated electrically heated homes we have noticed a vapor formation at the weatherhead as though the electrical conduit was venting some kind of heater.

Have you had similar experience to the above, and is such condition covered anywhere in the NEC?—W.M.R.

A. Some several years ago a deputy electrical inspector called to my attention a condition such as you describe. As far as I am able to determine, this is more of an engineering problem than a code problem. However, my thought is that probably something should be incorporated in the code that would prevent the condition that you explain. Since the power distributor in the other area mentioned had this trouble, a local requirement has been in effect that requires a small hole be drilled in the lowest section of conduit in order that condensation will drain from the entire conduit system in such as is shown in Figure No. 1. In this drawing the small hole is drilled in the meter socket as this is the lowest point. It is also a requirement in the above-mentioned area that the conduit fitting located immediately adjacent to the point of entry into or through a wall be packed with insulating material, such as fiberglass or spunglass non-combustible material. This is illustrated in Figure No. 2 at the point below the meter socket where a conduit fitting would be installed at the point of entry through the building wall into the heated area of the house.

Fig. 1

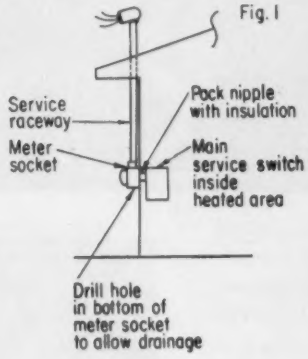
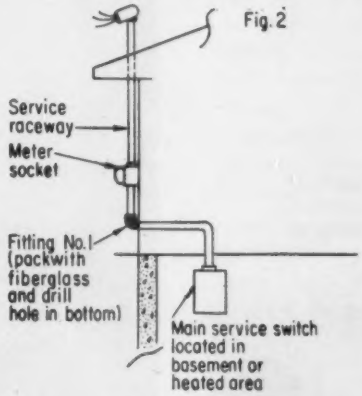

Service raceway
Meter socket
Pack nipple with insulation
Main service switch inside heated area
Drill hole in bottom of meter socket to allow drainage

Fig. 2


Service raceway
Meter socket
Fitting No. 1 (pack with fiberglass and drill hole in bottom)
Main service switch located in basement or heated area

My information from the field is that where such has been done as is outlined above, they have not encountered any trouble. The packing of the fitting effectively seals off the outside (cold section) from the inside (heated section). Of course, by drilling the small hole in either the conduit fitting or meter socket, drainage will be provided unless such opening should become clogged.—R.E.W.—4/61/1

Reader's Comment

"Regarding the wiring of range components on page 197 November issue of *Electrical Construction and Maintenance*, would not Fig. 2 violate Code Section 210-20(b)?

"A 3.2-kw oven draws 14 amps, hence, the branch fuse should not exceed 20 amps."—George W. Reed, Electrical Department, William Hood Dunwoody Industrial Institute, Minneapolis, Minn.

The above observation given by Mr. Reed is quite significant since it directs our attention to some code rules which appear to be out of focus with the logic which divides the safe from the hazardous. As a result, the two diagrams are being reproduced. Fig. 1 shows a 3.2-kw oven, rated 13.9 amps at 230 volts, connected to and protected by a 40-amp overcurrent device. Since Section 210-3 does not recognize a 40-amp branch circuit, there is a code violation which would be corrected if a 50-amp branch circuit with No. 6 conductors was installed. Under such circumstances, the 13.9-amp oven would be protected by an overcurrent device rated at 50 amps. Is this concept of safety correct or adequate, in view of the provisions of Section 210-20(b) which are quoted as follows?:

"Single Appliance. Overcurrent Protection. Shall not exceed 150% of the rating of the appliance, where the circuit supplies only a single appliance of 10-amp or more rating."

On the basis of this code rule, Mr. Reed questions the connection of a 13.9-amp oven on the No. 10, 30-amp individual branch circuit illustrated in Fig. 2. 150% of 13.9 amps is 20.85 amps, which is the maximum size of overcurrent device recognized for the protection of this oven unit. As a result, it appears

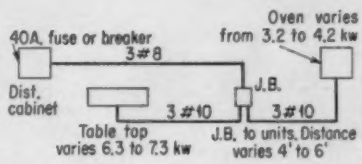


Fig. 1

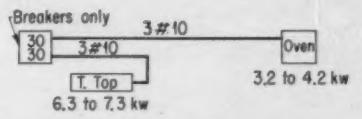


Fig. 2

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obvious that either No. 10 or No. 12 conductors could be used provided either was protected by a 20-amp overcurrent device. Under Section 240-5, the code provides latitude for the condition that results when the standard ratings and settings of overcurrent devices do not correspond with the allowable current-carrying capacities of conductors, by recognition of the use of the next higher rating or setting of the overcurrent device. This rule only concerns conductors. If it applied to appliances a 30-amp circuit breaker could be used as shown on the diagram. But since it does not apply, the oven must be protected by a 20-amp overcurrent device in accord with Mr. Reed's observation.

If the foregoing code logic is correct, we have a situation where the 13.9-amp oven is considered to be properly protected when connected to a 50-amp branch circuit, as shown by Fig. 1, but it is not considered to be properly protected by a 30-amp circuit breaker as shown by Fig. 2. What is the distinction in hazard which warrants such an apparent paradox? Does the code recognize the connection of a 13.9-amp oven to a 50-amp branch circuit? Such are the questions which arise when code rules are somewhat obscure in other Articles of the code. According to the provisions of Section 422-20, which concerns the overcurrent protection of appliances, the following is quoted:

"(a) Appliances, other than such motor-operated appliances as are required by Article 430 to have additional overcurrent protection, shall be considered as protected against overcurrent when supplied by one of the circuits of Article 210 and in accordance with the requirements therein specified."

This rule makes no distinction between a portable or fixed appliance. The provisions of Section 422-13, however, establish the status of wall-mounted ovens and counter-mounted cooking units, regardless of rating, as fixed appliances. The provisions of Section 210-24, under Article 210 indicate that a fixed appliance, provided the rating is not more than 24 amps, may be connected to a 30-amp branch circuit in any type of occupancy. The same rule recognizes the connection of fixed cooking appliances, regardless of rating, to a 50-amp branch circuit. In the absence of any other rule under Article 210, to the contrary, it appears obvious that a wall-mounted oven and a counter-mounted cooking unit may be connected to a 50-amp branch circuit, and such units, regardless of ampere rating, are considered to be adequately protected by a 50-amp overcurrent device. In other words, the 13.9-amp oven may be protected by a 50-amp overcurrent device when connected to a 50-amp branch circuit, but it must be protected by a 20-amp overcurrent device when connected to an individual branch circuit. It appears to me that such code logic is inconsistent. Of course there is no occasion to exceed the 150% protection when an individual branch circuit is involved other than the fact that a future cooking load could be added at a minimum of expense.

As evidenced by the article "Wiring Built-in Cooking Appliances," which appeared in the June 1960 issue of EC&M, John H. Watt, associate editor, has made a thorough study of the various code rules which concern this subject. He directs our attention to the provisions of Section 210-20(b) which only concerns single appliances of 10 amps or more rating. What about a single appliance rated at less than 10 amps? The apparent paradox which results is reflected through the following example cited by Mr. Watt in a letter to me.

"Although Paragraph 210-20(b) limits the size of overcurrent devices protecting an appliance served by an individual branch circuit to 150% of the appliance rating, it only applies to appliances rated 10 amps or more. A practical example is the case of a 230-volt, 2000-watt counter griddle. Such an appliance can be connected to a No. 10, 30-amp individual branch circuit, but if the appliance had a 2500-watt rating the overcurrent device could not exceed 150% times 10.8 amps or 15 amps.

"As far as I am concerned, this code provision should be clarified so that it would apply only where the individual branch circuit exceeds 50 amps. The reason I suggest this is that two or more fixed cooking appliances can be connected to any branch circuit from 15 through 50 amps without regard to the 150% factor mentioned in Paragraph 210-20(b).

"Another practical aspect involves adequate wiring. For example, sometimes a 30-amp, No. 10 branch circuit will be installed to serve a 230-volt, 2500-watt appliance initially, with the thought in mind of future additions. This often occurs in commercial installations for small cooking appliances found in restaurants."

In order to clarify the cloudy atmosphere which prevails, it appears that a new rule, Section 210-20(c) should be added to the code covering the status of the overcurrent protection for appliances connected to 30- and 50-amp branch circuits.

As far back as 1940, the code has limited overcurrent protection for an appliance connected to an individual branch circuit, as evidenced by the following quoted rule:

"Section 2173. Overcurrent Protection. 1940 Code. Overcurrent devices shall have a rating or setting not in excess of the carrying capacity of the conductors of the circuit and not exceeding 150% of the rating of the appliance."

According to this rule, a 5-amp appliance served through an individual branch circuit is required to be protected by a 7.5-amp overcurrent device. Since this was not intended the rule was changed in the 1946 Code to apply only to a single appliance rated 10 amps or more. While this code revision satisfied the objective in 1946, it appears evident, from Mr. Watt's example, that the concept of safeguard which results is inconsistent.

While I am not advocating an increase in the overcurrent protection of an appliance connected to an individual branch circuit, in the interest of consistent reasoning, it appears that the 150% limitation should be revised to 250%. This would tend to bring both rules more in focus. —B.A.McD.—4/61/2

Open Span Conductors

Q. *The last paragraph of Section 7321-b of the 1956 Code gave the separation requirements of conductors in open spans. Where is this wording found in the 1959 Code and what is the minimum spacing of conductors in open spans?—A.B.*

A. Actually the spacing requirements were located in Section 7322 of the 1956 Code.

Section 730-12 states the requirements formerly found in Section 7321-a. The requirements of Section 7321-b are now in Section 730-13.

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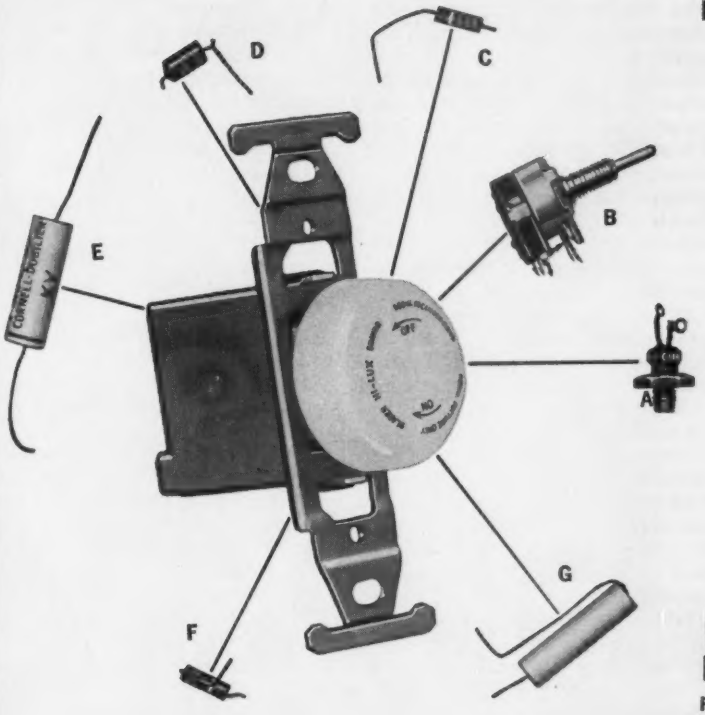

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The spacing requirements found in old Section 7322 are now in Section 730-14. It should be noted that this new section is editorially quite different. Basically the requirements are the same but are now tied in by direct reference to the requirements as set up for service entrance conductors in the first three paragraphs.—B.Z.S.—4/61/3

Space Heating vs Air Conditioning Load

Q. *Assume the nameplate rating of the space heaters to be the largest load. The air cooling load would be omitted for purposes of calculation. However, since a demand factor may be applied to the heating units, it is possible that the air cooling could impose the larger estimated load on the system.*

Under these conditions, which load should be used in the design of an electrical system—the heating or cooling load?—B.K.

A. The larger possible load should be used. If the demand factor is applicable to the heating load and under the conditions stated in Table 220-7 and, as a result, this is smaller than the connected air conditioning load, then the air conditioning load shall be used to determine the minimum size of service-entrance conductors and feeders.—B.Z.S.—4/61/4

Protection of Underground Service Conductors

Q. *Are underground service conductors required to be protected by overcurrent protection before they enter the ground?—R.B.*

A. That portion of a service which constitutes the underground service conductors is called a service lateral, and is defined by the code as follows:

"The underground service conductors between the street main, including any risers at a pole or other structure or from transformers, and the first point of connection to the service-entrance conductors in a terminal box inside or outside the building wall. Where there is no terminal box, the point of connection shall be considered to be the point of entrance of the service conductors into the building."

The service, entrance conductors for an underground system are defined as the service conductors between the service equipment and the point of connection to the service lateral.

According to the provisions of Section 230-90 of the code, each ungrounded service-entrance conductor shall be protected by an overcurrent device, having a rating or setting not higher than the allowable carrying capacity of the conductor. There are a few exceptions to this rule. Section 230-91 advises that the overcurrent device shall be an integral part of the service disconnecting means or shall be located immediately adjacent thereto, unless located at the outer end of the service.

It is significant to note that both of these code rules concern the overcurrent protection of service-entrance conductors, and are in no way concerned with the overcurrent protection of a service lateral. Since the code does not cover the overcurrent protection for a service lateral, the answer to your question is in the negative. The code does not require underground service conductors to be protected.—B.A.McD.—4/61/5

Voltage Limitation Appliance Circuits

Q. *Section 220-3 (b) seems to suggest the use of 3-wire 115/230-volt branch circuits serving the receptacle outlets for small appliances in the kitchen, laundry, pantry, dining room and breakfast room of dwelling occupancies. However Section 210-6(b) limits the voltage between conductors supplying receptacles to not exceeding 150 volts. None of the three exceptions seem to apply to receptacle outlets as commonly used in dwellings. Please explain.—R.B.F.*

A. The fine print note following Section 220-3(b) is quoted as follows:

"A 3-wire 115/230-volt branch circuit is the equivalent of two 115-volt receptacle branch circuits."

This note does not intend to infer that there is any code preference for a 3-wire circuit. It first appeared in the 1953 Code for the purpose of clarifying the status of a single 3-wire 115/230-volt circuit. Is a single 3-wire 115/230-volt circuit equivalent to two 115-volt branch circuits? This was the point of contention, and the fine print note answered the question in the affirmative.

For the convenience of our readers, the provisions of Section 210-6(b) are quoted as follows:

"(b) Voltage Between Conductors—Dwellings. In dwelling occupancies the voltage between conductors supplying lampholders of the screw-shell type, receptacles, or appliances, shall not exceed 150 volts, except as follows:

"Exception: The voltage between conductors may exceed 150 volts when supplying only:

"(1) Permanently connected appliances,

"(2) Portable appliances of more than 1,380 watts.

"(3) Portable motor-operated appliances of ¼ hp or greater rating."

There is no conflict with respect to the two rules involved. The general use of 3-wire 115/230-volt branch circuits in a residential occupancy has been common practice for many years. Such circuits usually serve receptacles rated 15 amps at 125 volts, which eliminates the use of 230-volt appliances. With the advent of the combination duplex receptacle with a dual rating of 15 amps at 230 volts, and 15 amps at 125 volts, a question has arisen with respect to the use of such combination receptacles on a 3-wire appliance branch circuit. This question has been the source of considerable discussion at several meetings of the International Association of Electrical Inspectors. E. F. Cogan, Secretary of this Association, comments as follows:

"First of all, under Section 220-3(b), Receptacle Circuits, Dwelling Occupancies: the rating of the appliance circuit is 20 amps at 115 volts and although the fine print note below this Section states 'a 3-wire 115/230-volt branch circuit is the equivalent of two 115-volt receptacle branch circuits, it implies that the maximum voltage for the appliance circuit would be 115 volts."

He further expresses the opinion "where the dual-voltage rating is used, it would be necessary to run two distinct circuits at both voltages to the receptacle in which the higher voltage would be a specific circuit but not an appliance branch circuit in the general use of the term."

This concept of the rule appears to be correct, and back in the 1940 Code, when it first appeared as a

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mandatory requirement, the intent, as interpreted over the years, visualized the use of 115-volt branch circuits to serve such small appliances, either in the form of 2-wire circuits, or a 3-wire circuit.

When this rule was originally formulated, it was very questionable that the use of a 230-volt appliance was considered as coming within the scope of appliances to be connected to an appliance circuit.

It appears evident from the foregoing that the status of a 230-volt receptacle on an appliance branch circuit is questionable. One could visualize occasions where the exceptions covered by Section 210-6(b) would apply. The question needs code clarification, and in the meantime it appears that the voltage of an appliance branch circuit should be limited to 150 volts between conductors.—B.A.McD.—4/61/6

Compressor Motor Starters

Q. *Does the code require either magnetic or manual starters for refrigeration compressor motors in the ¾- to 5-hp range?—M.F.*

A. Either type may be used. In Paragraph 430-81 the general provision states that the provisions of Part G of this Article 430 are intended to require a suitable controller for motors.

In Paragraph 430-81(a) of this same section, the definition of a "controller" is referred to as that given in Article 100, which states:

"Controller. A device, or group of devices, which serve to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected."

It should be noted that this does not limit the manner in which power to the connected apparatus is to be governed.

Furthermore, in this same paragraph there is a second general statement which says:

". . . the term 'Controller' includes any switch or device normally used to start and stop the motor."

The sealed (hermetic-type) refrigeration compressor motor, as such, is specifically discussed in this Part G only in Exception No. 3 of Section 430-83. This exception sets up the rules for determining the proper rating of the controller but does not in any way limit it to either a magnetic or a manual starter type.—B.Z.S.—4/61/7

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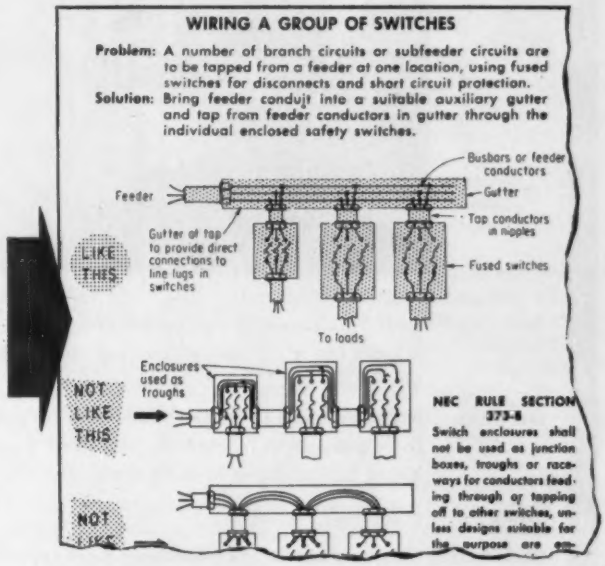
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Feeder
Gutter
Tap conductors in nipples
Gutter at tap to provide direct connections to line lugs in switches
LIKE THIS
Fused switches
To loads
Enclosures used as troughs
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NEC RULE SECTION 373-8
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"Notes from underground"

A short play on words and conduit

White hat: Boy! This tunnel is sort of airless and closed-in, isn't it? Almost like a . . . well a . . . never mind. Show me those steel raceways.

Dark hat: Right here. Been buried down here for years, but they look good as new. How do you think you'd look after being buried down here all those years?

White hat: Miserable, miserable.

Dark hat: You don't have to cover these steel raceways with any organic material when you run them through concrete, or along it.

White hat: Great! Just the kind of good, solid facts I need. Now let's get back topside, shall we?

Dark hat: You don't have to baby steel conduit, either. It takes plenty of rough handling and you can bend it without worrying about flattening or wrinkling.

White hat: About wraps it up, doesn't it? Let's go up and get some of that fresh air.

Dark hat: And steel conduit's a snap to install. You can thread it with regular dies and you don't need special lubricants.

White hat: I see.

Dark hat: Steel conduit gives you a grounded metallic system; induced currents are drained off without danger.

White hat: Let's ah . . . let's go up, huh?

Dark hat: Steel conduit's got a smooth interior, too; makes it easy to pull wires and cables, and saves a lot of time and money if you ever have to rewire. What's the matter, mister? You look all white. Maybe you ought to loosen your tie. Mister? Hey, mister?

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Wiring Conference Previews Sales Plan

Under National Wiring Bureau sponsorship, 200 delegates from electrical contractors, utilities, distributors, manufacturers and associations met in Chicago on February 23-24 for the 12th Annual National Wiring Sales Conference to preview national sales programs and to hear reports on successful local and regional plans for wiring promotion.

Herbert E. Cook, executive secretary of the Michigan Electrical Industry Association and chairman of the Plan Committee of the National Wiring Bureau, conducted the meeting as Conference Chairman.

● **Wiring Research Urged.** Keynoting the conference E. O. George, vice president of the Detroit Edison Co., called for cooperation among all the segments of the industry toward the problems of better residential wiring systems.

"We promote better wiring without making better wiring available to our builders, contractors and customers," he said, and recommended "developing a complete wiring system to meet our loads of tomorrow—systems that will make it possible for our customers to obtain all the energy they want, where they want it and at a cost in keeping with the value of the service." He concluded his remarks with the expressed hope that a research foundation be established toward this end.

Coincidently, Martin Bartling, assistant to the president of United States Gypsum Co., later called for industry research "to find a rational solution to the problem of wiring systems." He urged, "before another year is passed, we have a task force working to solve these problems."

● **EEI "Housepower" Advertising,** John F. Roberts, assistant sales manager, Philadelphia Electric Company, and John C. Catherwood, coordinator of Market Development and Training for the Long Island Lighting Company, Mineola, N. Y., described how Dorothy Collins, TV Star, will help sell wiring and Full Housepower during the year. Miss Collins' picture will appear on all National Wiring Bureau materials announcing "Dorothy Collins' Bright Idea! Full Housepower Makes a Happy Home." In addition, EEI will run a double-page Housepower ad in *LIFE, Better Homes and Gardens* and *Saturday Evening Post.* The Bureau will tie-in with the *Post* ad in the Fall, with a contiguous half-page, black and white ad of its own. This Bureau ad will aid local promotion because: (1) it will be oriented to the local electrical contractor, and (2) it will, in some cases, be substituted with a local ad which will appear in those copies of the *Post* circulated in a particular state. This arrangement, according to the speakers, under the *Post's* "Select-A-Market" plan, is expected to stimulate considerable interest among the country's promotion-minded utilities, leagues and contractor-groups.

● **Commercial Workshop For Contractors.** Porter Henry, Jr., president of Porter Henry & Company, Inc., New York, described the forthcoming "Commercial Wiring Profit Workshop." It will be a six-hour course divided into sessions for either one full day or two half days of intensive training for electrical contractors. The course is intended to create an interest among contractors to promote wiring modernization in the commercial market and teach him exactly how to go about it. The Workshop is sponsored by the Bureau in cooperation with the National Electrical Contractors Association. It will be available for everybody, however, anywhere one is scheduled.

● **Keep Pace Electrically.** The Bureau's advertising campaign was described by Sidney C. Blumenthal, Jr., president of Blumenthal-Kahn Electric Company, Baltimore, and chairman of NWB's Commercial Task Group. The ad campaign comprises four different full-page black and white ads in the three publications, *Business Week, Nation's Business* and *Today's Business.* Mr. Blumenthal explained the creative, well-conceived approach to the businessman to stimulate his thinking in terms of electricity to do the job better. The ads feature the "Keep Pace Electrically" emblem.

● **LOOK Awards Presented.** Again the meeting provided the backdrop for the Annual LOOK Magazine awards to winners of the 7th Annual Residential Wiring Promotion Competition. Trophies and plaques in five categories went to utilities, contractors, distributors, and leagues. "Oscars" went to: R. C. Electric Company (electrical contractors) of Milwaukee; Farrell-Argast Electric Company (distributors) of Indianapolis; The Electric Institute of Washington, D. C. (leagues); Pennsylvania Power & Light Company, Allentown, Pa.; Alabama Power Company, Birmingham; and Dayton Power & Light Company, Dayton, Ohio (utilities).

Special citations went to: K. J. Kenny Company, Mineola, N. Y.; Reddy Electric Company, Louisville, Ky.; and Morris Electric, Levittown, Pa. (all contractors); Howland Electric Wholesale Company, El Monte, Calif. (distributor); The Electrical Construction Industry Council, San Jose, Calif. (league); Niagara-Mohawk Power Corporation, Albany, N. Y., and Kentucky Utilities Company, Lexington, Ky. (utilities).

● **Electrical Contractors Report.** Three electrical contractors, from different parts of the nation explained how they tackled the wiring promotion problem. Emmett Pritchett of R. C. Electric, Milwaukee, described their promotion-minded operation in the field of residential wiring. G. B. Thornton, president of Thornton Electric Company, Niles, Mich., spoke about their successful and profitable electric heating and insulation business. The company increased its business 78% since entering into the electric heat field. Over 400 installations, a large portion of which were existing home conversions, give the company an excellent base of satisfied users for references.

Another contractor, William N. Collins, Collins Electrical Construction Company, St. Paul, Minn., described an effective method of developing new business in the commercial wiring modernization market. Commercial lighting, he said, is one of their best markets, limited only by "the limit of one's imagination."

Harold A. Webster, president of the National Electrical Contractors Association and president of T. Frederick Jackson Company, Inc., Long Island City, N. Y., urged all segments of the industry to work together in the interests of the public, the industry and toward realistic goals of progress and sensible profits.

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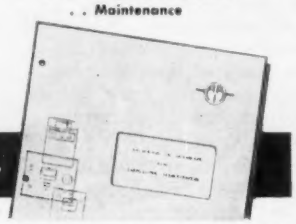

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Contractors Go to College for Short Course in Estimating

Management and supervisory personnel representing electrical contractors from six states spent two rewarding days on the University of Wisconsin campus in Madison. They were there February 14 and 15 to attend the annual Engineering Institute on Estimating in Electrical Contracting. This short course, sponsored by the University Extension Division and the College of Engineering, was held in the modern Wisconsin Center Building devoted solely to adult education.

As in the past, the "faculty" was drawn from the electrical construction industry. Instructors and lecturers included: Ralph H. Decker, consulting electrical engineer and estimator, Decker Associates, Inc., Park Ridge, Ill.; John J. McLaughlin and James E. Dow, vice presidents, Kelso-Burnett Electric Co., Chicago; and E. A. Gould, Jr., president, Gould Electric Co., Chicago. The full agenda covered contractor sales activities, labor-management relations, control of "lost labor," and the effectiveness of comprehensive and accurate estimating in the operation of a successful contracting business.

While analyzing sales plans for electrical contractors, J. J. McLaughlin referred to some of his own experiences in handling sales activities. Kelso-Burnett hires sales-minded personnel, trains them for customer-contact work, then backs them up with suitable promotional material. Strange as it may seem, the prime objective

LOST TIME on jobs means lost dollars warns E. A. Gould, Jr., president, Gould Electric Co., Chicago, as he outlines control methods at recent two-day electrical contractor seminar at University of Wisconsin. It costs the contractor about eight cents per minute per man per day for electricians' time, he estimated.

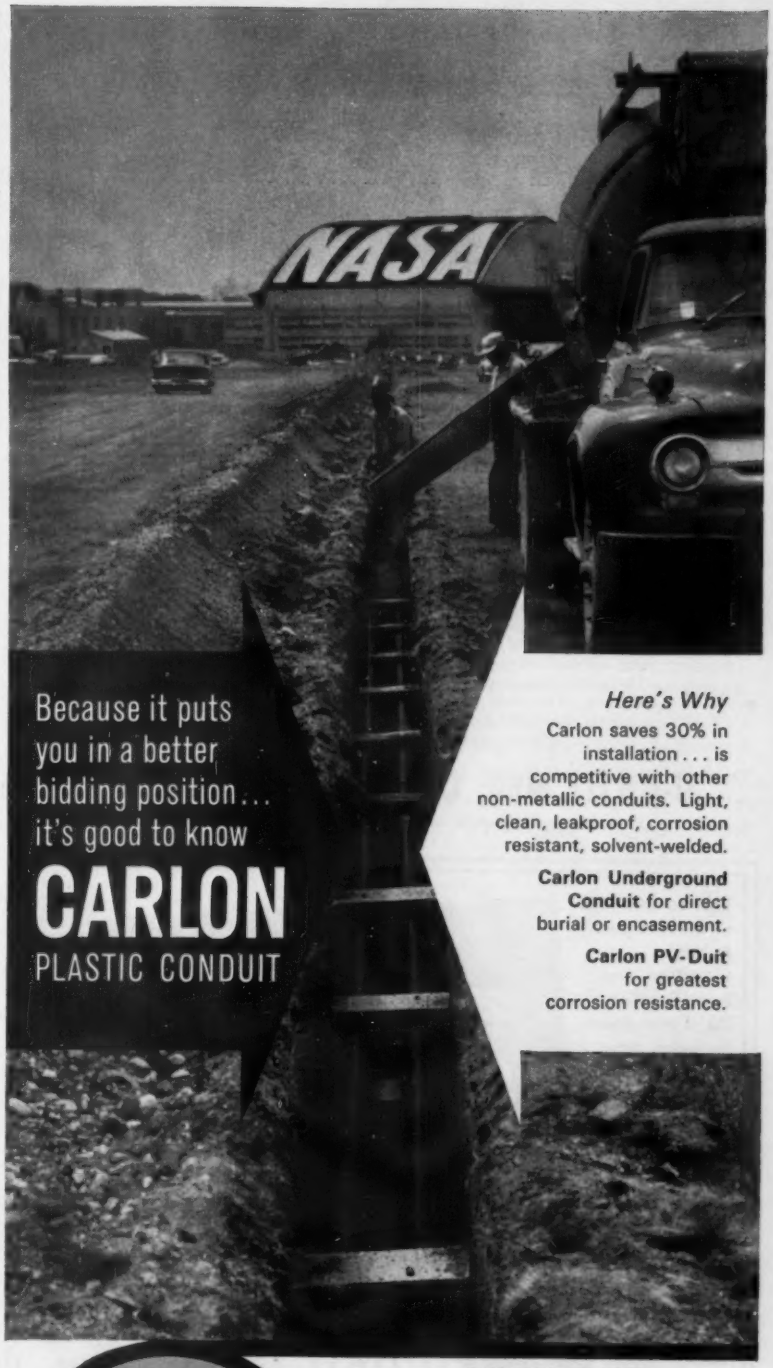
USE A SYSTEMATIC estimating procedure to develop accuracy and proficiency, counsels Ralph H. Decker, Park Ridge, Ill., electrical engineering and estimating consultant, as he conducts a two-day seminar for electrical contractors at University of Wisconsin.

of their sales department is to make contacts and develop customer prospects for the engineering department—not to get orders. And it works.

After only three years promotion in the commercial real estate field (office buildings, etc.), K-B anticipates $1 million of new business in this field this year. A similar program in the industrial field is in operation, he added. After sales calls were made on some 600 plants screened from an original group of 6,000, a final list of 50 has been developed for concentrated effort. General theme is to promote in-plant electrical construction for contractors and let plant crews concentrate on maintenance. A good benchmark for your own sales projection is the kilowatt-hour sales projection of your local utility company, McLaughlin concluded.

During his discussion of labor-management relations, J. E. Dow covered the fine points of resolving jurisdictional disputes and other grievances that may come up on electrical projects. He also explained the operation of the Chicago Seniority System which replaced the union hiring hall in 1948.

At prevailing wage rates, it costs the contractor about eight cents (including insurances) per minute per man per day to have an electrician on a job, noted E. A. Gould, Jr. Lost minutes on the job can quickly add up to lost dollars for the contractor, he warned. To control "lost time," Gould recommended that each job have: clear work orders; proper tools; complete supply of materials properly segregated; clear, definitive plans; proper supervision; well organized crew operation and workmen's ad-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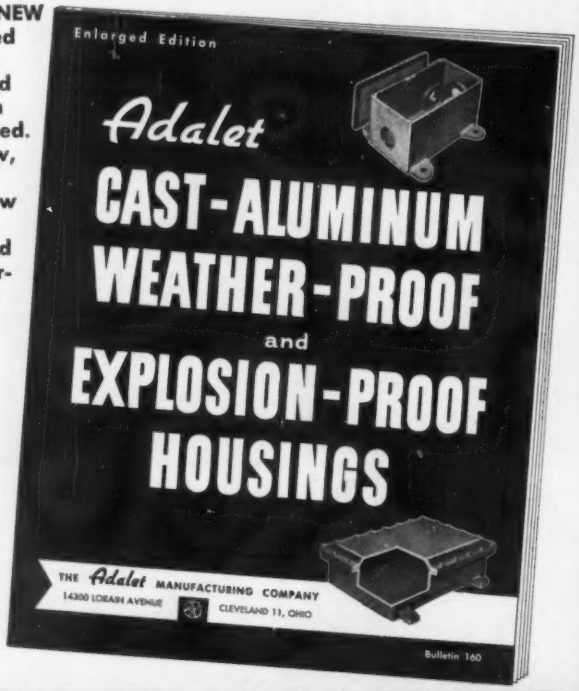

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CONTRACTOR SALES departments should concentrate on making contacts and developing prospects for the firm's engineers, John M. McLaughlin, vice president, Kelso-Burnett Electric Co., Chicago, tells contractor "students" at recent two-day seminar for electrical contractors at University of Wisconsin.

herence to "on time" arrival, lunch and departure.

More than half of the two-day session was devoted to estimating principles under conference leadership of Ralph H. Decker. Mr. Decker recommended specific estimating procedures and techniques he developed and refined over 57 years of experience in electrical contracting, engineering and estimating. A prerequisite of good estimating is accuracy and proficiency in takeoff and checking, he noted, adding that speed follows development and adherence to a systematic procedure.

Continued high, low, or unbalanced bids generally indicate faulty estimating. Such catch-all words as "miscellaneous" or "sundries" have no place in an accurate, detailed estimate and nothing should be listed that cannot be specifically identified or justified, Decker advised. Other pertinent recommendations: do not work under pressure; carefully study plans and specifications and make systematic notes; check architectural, structural and other relevant plans; take off heavy equipment items first so prices can be secured in time; add 6% to 8% to manhour totals for normal lost time on the job; add a reasonable and proper markup to the estimated cost.

As to markup, Mr. Decker reviewed and compared three established practices: 1) Percent of Prime Cost (straight percentage of material and labor total); 2) various percentages of segregated equipment and material costs, and labor to get total markup; 3) Dollar per Labor Hour (hourly rate method) wherein the hourly rate of markup is determined by dividing the overhead and profit total by the annual productive manhour

total. Expressing a preference for the latter method, Decker contends that an electrical contracting business is productive only when mechanics are working. With the hourly rate method, management can definitely determine how much must be recovered each day in order to meet expenses and have a profit, he concluded.

Throughout the sessions, "student" attitude reflected a sincere resolve to acquire knowledge that would help each one in his specific business operation. Notetaking was widespread. Questions were numerous; answers specific.

Lighting Show Accents Trends

The 3rd National Lighting Exposition, held in New York's huge Coliseum, March 5-8, featured 250 exhibits of lighting equipment, light sources and lighting components, and a nine-session World Lighting Forum. The exposition was attended by nearly 17,000 members of the lighting industry and allied trades.

Featured in the exhibits were the newest developments in light sources—incandescent, fluorescent, and mercury vapor—and a wide variety of commercial, industrial, residential, floodlighting, and street and highway-lighting luminaries and related components and accessories. Also on display were many new developments in theatre and stage lighting units, dimmer equipments, dimmer consoles and preset arrangements. Of interest to most visitors were many exhibits of lighting components and accessories, such as ballasts, metal and plastic louvers, lenses, diffusing panels, and light-control devices. And of special interest to lighting engineers generally were new luminairies and floodlights designed specifically for the new quartzline lamps, and combination lighting-air conditioning troffers, representing recent equipment advances and lighting technology. The Exposition's over-all theme of "Lighting for Today and Tomorrow" was well portrayed, not only by the exhibits and displays, but also by the nine symposiums of the World Lighting Forum, which attracted a paid attendance of 1710 individuals.

The symposiums were participated in and conducted by 33 of the lighting industry's top authorities and leaders. Each symposium

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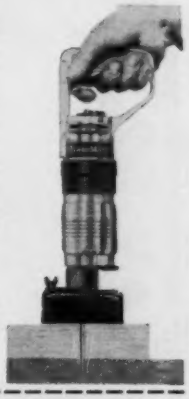

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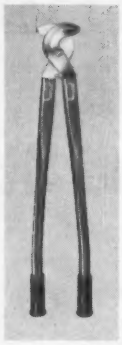

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was devoted to a separate topic of current popular interest, with special emphasis on the tremendous scientific advances which have recently been and are still being made within the industry and the many problems which automatically result. Among the topics discussed were lighting as it relates to architecture, visual environment, new light sources, and lighting for streets and highways, outdoor recreation, residences, and entertainment (theatre, high school auditoriums, art objects, etc.).

The Lighting Forum sessions were opened by G. J. Taylor, past-president of the Illuminating Engineering Society, and vice president of Day-Brite Lighting, Inc., serving as over-all moderator.

The keynote opening address was made by R. G. Slauer, president of the Illuminating Engineering Society, and manager of engineering of the Fixture Division, Sylvania Electric Products, Inc. "There are many places where 'light' influences economic growth," Mr. Slauer said, after reviewing the current discussion on national economy growth by Federal officials and President Kennedy. These places include "in education, in production, through improved environment, and through elimination of waste (traffic accidents, for example)," Mr. Slauer explained, in pointing out that the growth of the lighting industry has greatly exceeded national economic growth.

The first symposium covered "Integration of Lighting, Heating and Air Conditioning," and was moderated by Douglas Haskell, editor of *Architectural Forum*. The speakers were M. L. Quinn of Day-Brite Lighting, Inc., and Robert Gand of Benjamin Division, Thomas Industries Inc. These panelists presented an integrated slide history of the techniques and practices of lighting and air conditioning, showing how building design practices, modular treatments, and continuing cubicle-space reductions have led to the current trend of combining lighting systems and air-conditioning diffusers and equipment into one integrated system.

The "Success of the New Recommended Higher Footcandle Levels for Offices, Industry and Institutions" was presented by three panelists: C. L. Amick of Day-Brite Lighting, Inc., E. A. Linsday, of Large Lamp Department, General Electric Co., and H. J. Wald, consulting engineer of Wald & Zigas. G. J. Taylor served as moderator. Mr. Amick reviewed the

growth of lighting levels over the past 60 years, based on IES standards, and discussed the research work of Dr. Richard Blackwell, which led to the adoption of new IES lighting level recommendations based on "light-in-the-seeing tasks." Mr. Linsday described lighting as the common denominator for economic and business growth, and related light to "controlled" visual environments. Using color slides, he showed many lighting jobs which have lighting levels which far exceed the new IES lighting levels, described the lighting equipments and methods used, and related lighting costs to production costs, wages, and various consumer commodities. "The new IES recommended levels (minimum values) are already obsolete," he said, "since they do not provide optimum seeing conditions." Mr. Wald described the functions of the architects, and of the consulting engineers in lighting application. He reviewed the impact of the new IES lighting levels on electrical systems design, and stressed the importance of lighting maintenance, which demands more attention than ever. The increases in lighting levels have been generally accepted, he said, and ways are being devised to meet the inherent problems imposed.

A panel of three speakers discussed "New Light Sources and Their Application." A. K. Gaetgens of General Electric Co. covered fluorescent lamps, T. C. Sargent of Sylvania Electric Products Inc. covered incandescent lamps, and William S. Till of Westinghouse Lamp Division covered mercury vapor lamps. Lamp developments over the past several months were discussed in detail, including applications of some of the newer light sources.

A three-man panel, moderated by C. L. Crouch, Technical Director of IES, discussed "The Creation of Comfortable Visual Environment—Quality and Quantity." The panel consisted of C. W. Evans, editor, *Electrical South* and *Lighting*, G. W. Clark, manager of marketing for Lighting Division—Fixtures, Sylvania Electric Products Inc., and H. E. D'Andrade, Large Lamp Department, General Electric Co. Mr. Evans discussed the physiological and psychological factors involved in this subject. Mr. D'Andrade covered the architect's approach to a solution of a comfortable visual environment, and Mr. Clark related the eight basic factors of lighting design to visual environment problems.

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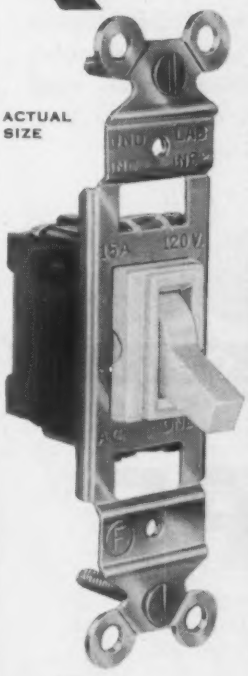

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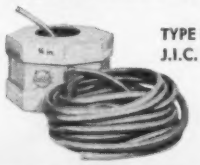

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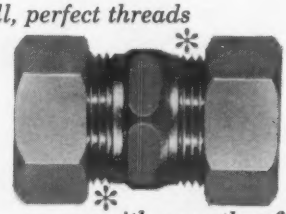

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"The Importance of Adequate Street Lighting" was discussed by four speakers, moderated by E. C. Powers, national director of the National Street and Highway Safety Lighting Bureau. The speakers were: Newbold Morris, Commissioner of Parks, City of New York; E. B. Karns, product manager of Westinghouse Lighting Division; Stacey Standley, lighting product manager, Line Material Industries; and J. J. O'Neill, director of the traffic and transportation division of the Greater New York Safety Council.

Three speakers discussed "Residential Lighting." Mrs. Judith York Newman, editor of *Living for Young Homemakers*, discussed the broader aspects of "Light for Living." S. R. Shemitz, president of C. S. Mersick Electric Supply Corp., pointed out the need for a new approach to lighting equipment design to meet the practical needs of the industry today, and illustrated new lighting methods by means of color slides. Elizabeth Meehan, residential lighting consultant, Philadelphia Electric Co., covered modern home lighting methods and practices and showed examples by means of color slides.

The subject of "Outdoor and Recreational Lighting" was discussed by three speakers, and moderated by W. C. Cummings, sales application engineer, Public Service Electric and Gas Co., Newark, N. J. Speakers were: J. R. Chambers, sales manager, Appleton Electric Co; W. W. Weld, chief application engineer, Revere Electric Mfg. Co; and T. S. Kelly, lighting consultant.

A three-man panel discussed "Esthetics of Lighting Pertaining to Entertainment—Theatre, High School Auditoriums, Art Objects, etc." This panel discussion was moderated by R. W. Dowling, president and director of City Investing Co., New York City. Panelists were: R. G. Williams, lighting consultant and director of Color Research, Century Lighting, Inc.; Dr. J. E. Rubin, director of the Theatrical Lighting Division, Kliegl Brothers Lighting; and Jean Rosenthal, president of Theatre Production Service, New York City.

The World Lighting Forum program was concluded with a symposium on "World Lighting and Its Effects." W. C. Brown, past president of IES, was moderator. Panelists were: Ruby Redford, editor, *Illuminating Engineering*; A. H. Feder, lighting consultant; and G. J. Taylor, vice president, Day-Brite Lighting, Inc.

EASA News

Attendance at EASA Management Seminars and Electronic Motor Control Courses is reflecting the increasing interest in such programs, according to Joseph M. Harrington, executive vice-president of the association.

"Our first Management Seminar, in Chicago last January, was enthusiastically received, and many have stated they would like to attend another similar three-day program in a year or so," Mr. Harrington said.

Other Management Seminars have been held in Detroit, in March, and are scheduled for Portland, Ore., April 20-22, and in New York, May 25-27. The programs consist of lectures and discussions on a variety of business management problems, and are directed by the faculty of the School of Commerce and Finance of St. Louis University.

The first of the Electronic Motor Control Courses opened in Philadelphia on March 6, and the second in Boston, March 20. Others are scheduled in Atlanta, April 3-7; Oklahoma City, April 17-21; Los Angeles, May 1-5; and Minneapolis, May 15-19.

• • • •

The seventh Southeastern EASA Technical Forum was held at the Manger Hotel on March 24-25 in Savannah, Ga.

Preliminary arrangements have been made for the annual Southeastern Conference, to be held at the Dinkler Plaza Hotel in Atlanta on November 2, 3 and 4.

• • • •

Election of officers of the St. Louis Chapter was held February 22 at Augustine's Restaurant in Belleville, Ill. Al Martin, of Zeller Electric, Inc., was elected president; Harold Willmann, of Briner Electric Co., vice president; and Jim French, of French-Gerleman Electric Co., secretary-treasurer. New directors are Norman Frese, of National Electric Service Co., and James C. Adams, of Quality Electric, Inc.

• • • •

The semi-annual meeting of the Southeastern Chapter of EASA was held March 23-25 in Lubbock, Texas, at Caprock Hotel. Speakers included: Robert A. Renaud, development engineer, Spencer Products Group, Texas Instruments, Inc., Attleboro, Mass.; Victor H. Lyon, regional sales manager, Eutectic Welding Alloys Co., Tulsa, Okla.; Walter O. Helwig, president,

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Helwig Carbon Products, Inc., Milwaukee, Wis.; Coy D. Evans, division personnel-safety supervisor, Southwestern Public Service Co., Lubbock; Richard A. Fremming, application engineer, Century Electric Co., Dallas, Texas; E. H. Olson, technical director, magnet wire research laboratory, Anaconda Wire & Cable Co., Muskegon, Mich.; Warren Norwood, sales engineer, American Sealants Co., Hartford, Conn.; and Horace Barks, of Horace Barks Publications, St. Louis, Mo., editor *EASA News*.

A separate program, including a museum tour, luncheon and hair style show, was held for women guests. The conference was entertained by Loen Hill, Texas humorist, and attended a local rodeo.

• • • •

The Greater Cleveland chapter met at Canton, Ohio on March 20. EASA Director Ed Potter and EASA Engineer August A. Baechle were the principal speakers.

• • • •

Dr. John Beeble and George Smith, of the Waterbury Heart Association, spoke to members of the Connecticut chapter on February 2 at Waverly Inn, Cheshire, Conn. At the same meeting the nominating committee presented its choices for new officers. They are: Ed Piteo, president; Joe Piola, vice-president; Ken Langillo, secretary; Jack Travers, treasurer; Al Lebowitz, Frank Johns, Nick Molfi, and Herman Blank, directors.

• • • •

Members of the Central District (Chicago) Chapter saw demonstrations of the Eddy Current Clutch by H. L. McCleery, of the McCleery Engineering Co., and the Klixon Motor Overload Devices by R. M. Parker, of Texas Instruments, Inc., at their February 7 meeting. At the close of the business meeting, Irwin Ross, hypnotist, entertained the members with the help of a dozen volunteers from the audience.

• • • •

The district convention of the Central Ohio chapter will be held in Columbus on May 6. All EASA members from Ohio and surrounding areas have been invited.

• • • •

The list of speakers for the EASA National Convention, to be held June 11-14 in San Francisco, will be announced shortly.

Registrations for the convention are being accepted at EASA Headquarters, 7730 Carondelet Ave., St. Louis 5, Mo.

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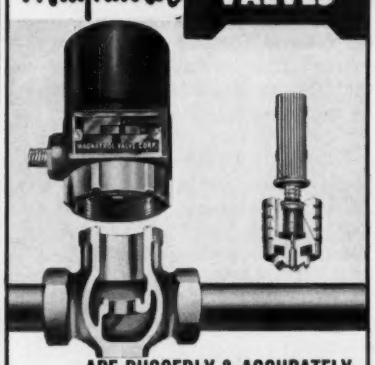

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DATES AHEAD

International Association of Electrical Inspectors — Chapter Meetings — **Alabama,** Tutwiler Hotel, Birmingham, Ala., April 17-18; **South Carolina,** Cabana Inn, Spartanburg, S. C., April 20-21; **Tennessee,** Andrew Jackson Hotel, Nashville, Tenn., April 24-25; **Five Chapter Joint Meeting,** Windsor Hotel, Abilene, Texas, April 28-29; **Florida,** Casa Marina Hotel, Key West, Fla., May 5-6; **Virginia,** Hotel Roanoke—Roanoke, Va., June 12-13; **Northwestern Section,** Owyhee Hotel, Boise, Idaho, September 11-13; **Southwestern Section,** Hotel Del Coronado, Coronado, Calif., September 18-21; **Western Section,** Biltmore Hotel, Oklahoma City, Okla., September 25-27.

Illuminating Engineering Society—Regional Conferences; **Southwestern,** Skirwin Hotel, Oklahoma City, Okla., April 17-18; **Southeastern/South Central,** Biltmore Hotel, Atlanta, Ga., April 20-21; **Inter-Mountain,** Salt Lake City, Utah, May 1-2; **South Pacific Coast,** Sacramento Inn, Sacramento, Calif., May 4-5; **Pacific Northwest,** Harrison Hot Springs, Harrison, B. C., May 8-9; **Canadian,** Queen Elizabeth Hotel, Montreal, Que., May 15-16; **Northeastern,** Berkeley-Carteret Hotel, Asbury Park, N. J., June 8-9; **Great Lakes,** Sheraton-Gibson Hotel, Cincinnati, Ohio, June 19-20.

2nd Annual Alabama Electrical & Electronics Exposition—Municipal Auditorium, Birmingham, Ala., Apr. 17-19.

15th New England Electrical Show—Sponsored by Electrical Manufacturers Representatives Club, Commonwealth Armory, Boston, Mass., April 18-20.

National Association of Electrical Distributors—53rd annual convention, Cobo Hall, Detroit, Mich., April 29-May 3.

National Fire Protection Association—Annual convention Hotel Statler, Detroit, Mich., May 15-19.

Edison Electric Institute—Annual convention, Waldorf-Astoria Hotel, New York, N. Y., June 5-7.

Electrical Apparatus Service Association, Inc.—28th annual convention, Jack Tar Hotel, San Francisco Calif., June 11-14.

New York State Association of Electrical Contractors & Dealers—62nd annual convention, Whiteface Inn, Lake Placid, N. Y., July 2-7.

Western Plant Maintenance Show—Pan American Auditorium, Los Angeles, Calif., July 18-20.

National Assn. of Lighting Maintenance Contractors—National conference, Las Vegas, Nev., August 21-23.

Western Electronic Show and Convention—Cow Palace, San Francisco, Calif., August 22-25.

American Home Lighting Fixture Month—Sponsored by the American Home Lighting Institute, Chicago, Ill., September 1-30.

Illuminating Engineering Society—National Technical Conference, Chase Park Plaza Hotel, St. Louis, Mo., September 24-29.

National Electrical Contractors Association—Annual convention, Washington, D. C., October 9-14.

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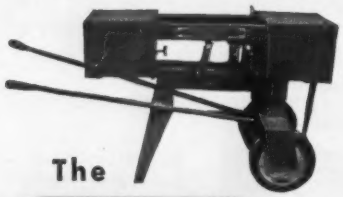

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Among the Manufacturers

Headquarters Announcements

Stanley Electric Tools, division of **The Stanley Works,** New Britain, Conn., has changed its name to **Stanley Power Tools.**

Paragon Electric Co., Two Rivers, Wis., announced its affiliation with the **American Machine & Foundry Co.** as a subsidiary under its Electrical Products Group.

Universal Motor Co., Oshkosh, Wis., has joined the **J. M. Nash Co.,** also of Oshkosh.

FWD Corp., Clintonville, Wis., has purchased the Wagner Tractor, Inc., Portland, Ore.

AMP Inc., Harrisburg, Pa.—Joseph Maher, product sales manager.

Gould-National Batteries, Inc., St. Paul, Minn.—A. W. Brunsell, vice president, Alkaline Sales; Donald J. Nedved, vice president, Sealed Cell Operations.

Art Metal Co., Cleveland, Ohio—T. D. Wakefield (executive vice president of the Wakefield Co., Vermilion, Ohio) has been elected president and general manager; D. A. Schisler, vice president of marketing; R. M. Brown, sales manager.

General Electric Co., Schenectady, N. Y.—Ralph J. Cordiner, president and chairman of the board.

Square D Co., Lexington, Ky.—James W. Hudson, manager—underfloor-duct planning, Distribution Equipment Div.

International Rectifier Corp., El Segundo, Calif.—Dr. George Krsek, executive vice-president and general manager.

Bohn Aluminum & Brass Corp., Detroit, Mich.—Edward N. Harris, vice president of sales.

Thompson Ramo Wooldridge Inc., Michigan City, Ind.—K. F. Petersen, general sales manager, Dage Div.

The Union Metal Mfg. Co., Canton, Ohio—Kenneth C. Dorland, general sales manager.

Auth Electric Co., Inc., Long Island City, N. Y.—Gordon Auth, director of product engineering.

Precision Transformer Corp., Chicago, Ill.—Blaine Beck, vice president of manufacturing.

Curtis AllBrite Lighting, Inc., Chicago, Ill.—Joseph R. Ray, vice president of sales.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—M. M. York, direc-

tor of industry coordination, Industries Group.

The Palo Alto Engineering Co., Palo Alto, Calif.—John C. Beckett, president; Roy A. Melin, vice president; Nick J. Mardesich, secretary-treasurer.

The Siegler Corp., Los Angeles, Calif.—General Phillips W. Smith, vice president.

Keystone Electric Mfg. Co., Philadelphia, Pa.—Herbert Wile, Jr., national advertising and sales promotion manager.

Sequoia Wire and Cable Co., Redwood City, Calif.—Albert H. Leader, vice president of sales.

Square D Co., Park Ridge, Ill.—John N. Daniel, division manager, Commercial Control Div., Asheville, N. C.; Walter R. Clarke, product manager, Marketing Div.

National Pneumatic Co., Inc., Boston, Mass.—Edward A. Moraski, manager of engineering.

Crucible Steel Co. of America, Pittsburgh, Pa.—Josef H. Buerger, Jr., director of sales.

International Resistance Co., Philadelphia, Pa.—John S. Kane, manager, Plastic Products Div.; Robert A. Bailey, director of special product marketing; Walter H. Powell, board of directors.

Mears Controls, Inc., Portland, Ore.—Charles A. Schmidt, vice president of sales.

Worthington Corp., Harrison, N. J.—Elliot M. Richman, supervisor of original equipment manufacturer sales, Resale Sales Dept., Marketing Div.

Philadelphia Gear Corp., King of Prussia, Pa. — William T. Brown, vice president of manufacturing; Harold O. Kron, vice president of engineering.

BullDog Electric Products Div., I-T-E Circuit Breaker Co., Detroit, Mich.—Hugh V. Diamond, Jr., product promotion manager of residential equipment; Richard R. Frede, product promotion manager of fusible equipment.

Simplex Wire & Cable Co., Cambridge, Mass.—Marshall A. Williams, executive director of marketing; Edward F. Galvin, manager of field sales.

Regional Appointments

NEW ENGLAND

Stocker & Yale, Inc.: G. Fred Stocker and Gardner Knapp, sales representatives in New England territory, Lighting Equipment Div.

Daystrom, Inc.: John L. Cattanach, manager of Boston district office, Weston Instrument Div.

Wagner Electric Co.: J. P. Miller, manager, Boston office.

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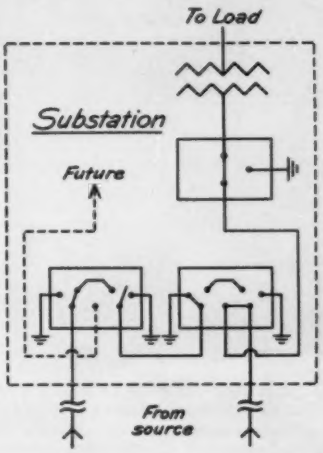

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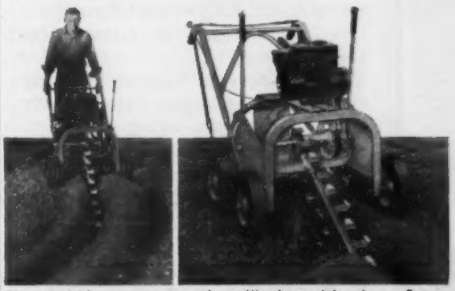

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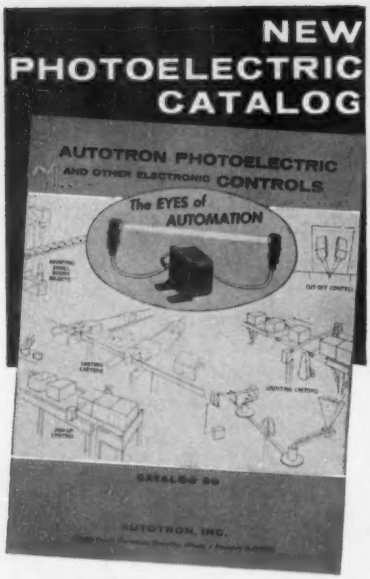

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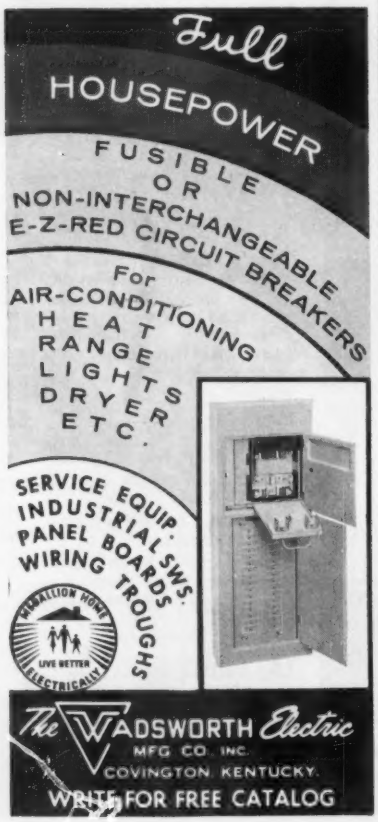

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Smithcraft Corp.: Goren-Newman, Inc., New York City, representative in the Metropolitan New York area.

Sunbeam Lighting Co.: Bert Wayne Electric Sales Co., Spring Valley, N. Y., representative in the New York City, Long Island and New Jersey areas.

Greenlee Tool Co.: Gene Tarabilda, representative in eastern sales office, Jamaica, N. Y.

Thor Power Tool Co.: Kenneth W. Nelson, regional sales manager with headquarters in Long Island, N. Y.

American Nikeloid Co.: Richard E. Nenno, sales representative in upper New York state, with offices in Buffalo.

Stanley Power Tools: Fred D. Clark, Jr., sales representative in northern New Jersey and Richmond and Rockland counties, N. Y.

Wagner Electric Co.: E. H. Reichel, manager of the New York Parts and Accessories branch office.

SOUTH ATLANTIC

Edwards Co., Inc.: Donald A. Wildauer, mid-Atlantic district manager.

The Okonite Co.: John P. Oblinger, manager of new Charleston, W. Va., branch office.

EAST CENTRAL

Wagner Electric Corp.: B. J. Wheat, manager of Cincinnati office.

Thomas Industries, Inc.: Wallace T. Rouse, manager of engineering for Ft. Atkinson, Wis., residential lighting fixture manufacturing plant.

Motorola Communications & Electronics, Inc.: Glenn A. Froberg, regional sales manager in Indianapolis; Ira Walker, regional sales manager in Memphis.

G & W Electric Specialty Co.: Boyle & Van Meter Co., Inc., Brookfield, Ill., sales representative in portions of Illinois and Indiana.

Allen-Stevens Conduit Fittings Corp.: The Henger-Fairfield Co., Cleveland, Ohio, sales agents.

Sylvania Electric Products Inc.: Max E. Doney, Cincinnati district sales manager, Lighting Products Div.

Markel Electric Products, Inc.: Jeff Bennett, representative in Kentucky and Indiana.

Bohn Aluminum & Brass Corp.: James R. Dissette, manager of plant in South Haven, Mich.

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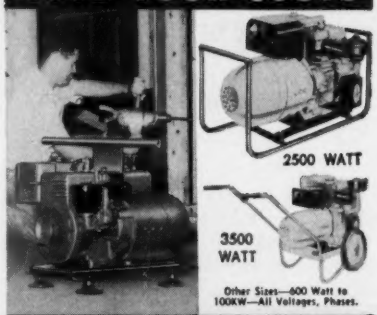

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Valley Manufacturing Co.: Lawrence B. Boensch Co., Birmingham, Mich., representative in Michigan and Ohio; Select Metals Products Co., Chicago, Ill., representative for Illinois, Eastern Iowa, Indiana, Wisconsin and Minnesota; Steel Lighting Pole Div.

Ilg Electric Ventilating Co.: Ray Long, branch manager, Detroit sales office.

WEST CENTRAL

Valley Manufacturing Co.: James Harbin, Lubbock, Texas, representative for Oklahoma and Texas.

Motorola Communications & Electronics, Inc.: Paul E. Russum, regional sales manager, Southern Area, headquarters in Dallas.

Edwards Co., Inc.: Robert L. Zell, area representative based at St. Louis office.

Keystone Mfg. Co.: W. D. Faust, sales representative located at New Orleans, La.

Owatonna Tool Co.: Richard Vandermoulon, district representative for the state of Iowa, Tools & Equipment Div.

Air Reduction Sales Co.: J. P. Casalis, Jr., district manager, St. Louis.

Harvey Aluminum: Gerald J. Johnson, manager of new Minneapolis office.

WEST

The Okonite Co.: James F. Angle, Rocky Mountain district manager in charge of Denver office.

Motorola Communications & Electronics, Inc.: Chester L. Pringle, regional sales manager in Denver.

Valley Manufacturing Co.: M. A. Bannister, Westminister, Colo., representative for the Rocky Mountain area.

Keystone Mfg. Co.: The Tal Agencies, Inc., Seattle, Wash., sales representative in Washington, northern Idaho and Alaska.

Kuhlman Electric Co.: Kuhlman Fluehr, western regional manager, headquarters in Salinas, Calif.

Edwards Co., Inc.: John E. Jones, northwest district manager based at San Francisco.

Diamond Expansion Bolt Co., Inc.: Lloyd George, west coast sales representative in San Francisco and northern California.

Allen-Stevens Conduit Fittings Corp.: Jim Bergman and Harry Marshall, Bergman-Marshall Co., San Francisco, Calif., sales representatives for northern California and Reno, Nevada area.

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GIMBAL RING* for PAR 38, 46, 56 and the 64 side prong lamps

GIMBAL RING* for R 30, R 40 and PAR 38 screw-base lamps

Design Your Line With Gimbals in Mind

ATI GIMBAL RINGS

have
MORE SALES APPEAL
VERSATILITY and ADAPTABILITY
QUALITY FEATURES
LONG LIFE CONSTRUCTION

*Cadmium plate, brushed chrome effect. Use as is or paint over.

Write or call for details

ATI **ALEXANDER-TAGG INDUSTRIES, INC.**
Hatboro, Pa. OSborne 5-7200

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(Classified Advertising)
EMPLOYMENT • BUSINESS
EQUIPMENT — USED OR RESALE
OPPORTUNITIES

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EQUIPMENT & BUSINESS OPPORTUNITY Advertising $21.00 per inch

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(Not available for equipment advertising)

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Discount of 10% if full payment is made in advance for 4 consecutive insertions.

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(ELECTRICAL)

Heavy Industrial & Power Distribution Must be Familiar with Take-Off, Pricing, Purchasing, & Sub-Contracts. Minimum Five (5) Years Experience. Excellent Opportunity with Large Midwestern Contractor. Send Complete Resume with Salary Requirements.

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SAVE! SAVE! SAVE!
Buy accurate, dependable, rebuilt WATTHOUR METERS for any electric service, and buy for less ! !
Also repair and recalibration service.
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CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

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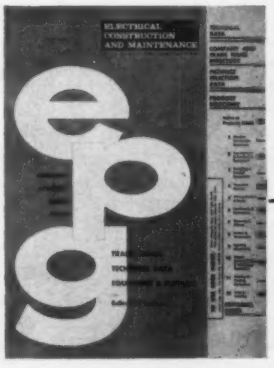
EQUIPMENT
(Used or Surplus New)
For Sale 209



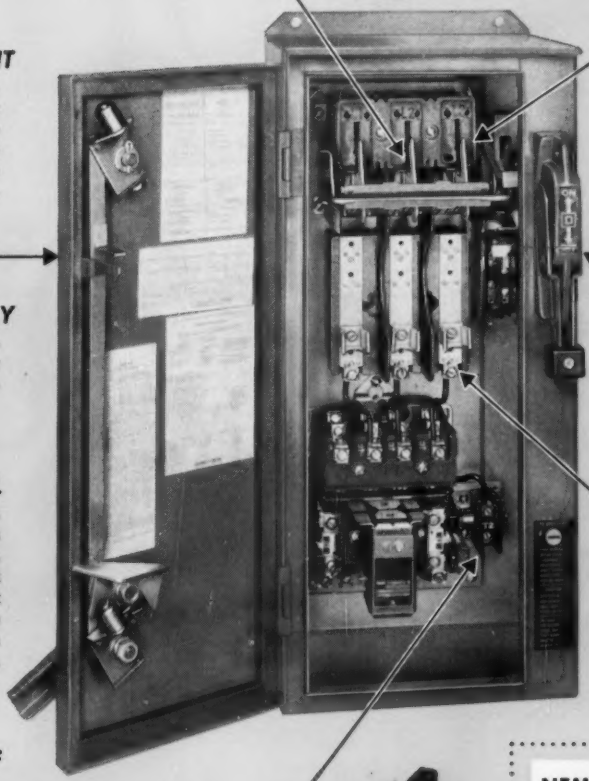
• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE ISSUE

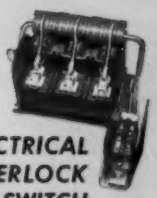
For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.

All these Square D features make this

THE SAFEST, MOST RELIABLE COMBINATION STARTER

VISIBLE BLADES You can see the switch is open and know you're safe!





REALLY DUST-TIGHT

NEMA 5-12 construction keeps out dust and coolant. Positive door-closing mechanism assures complete seal before switch can be operated.

DOOR CLOSES SIMPLY and EASILY

No cover bolts to secure—just push door shut and turn door handle to close and seal.

EASY TO INSTALL

Through wiring with no interference from disconnect switch. Line terminals are at top, load terminals at bottom. Starters can be ganged with less than ½ inch between them.

WIDE RANGE OF SIZES

New Square D combination starter now available in NEMA Sizes 0 through 4.

ELECTRICAL INTERLOCK ON SWITCH

Optional single or double-pole interlock available to disconnect separate control circuit power. Assures complete safety!

FOOL-PROOF OPERATING MECHANISM

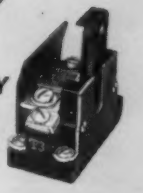
Handle is permanently attached to switch to eliminate hazard of false handle indication. With door open, the switch can not be operated accidentally.

CONVERTIBLE FUSE CLIPS

If horsepower or voltage requirements change, modification kits provide easy change of fuse clip size and spacing.

3rd OVERLOAD RELAY

Space to add an additional overload relay when desired.



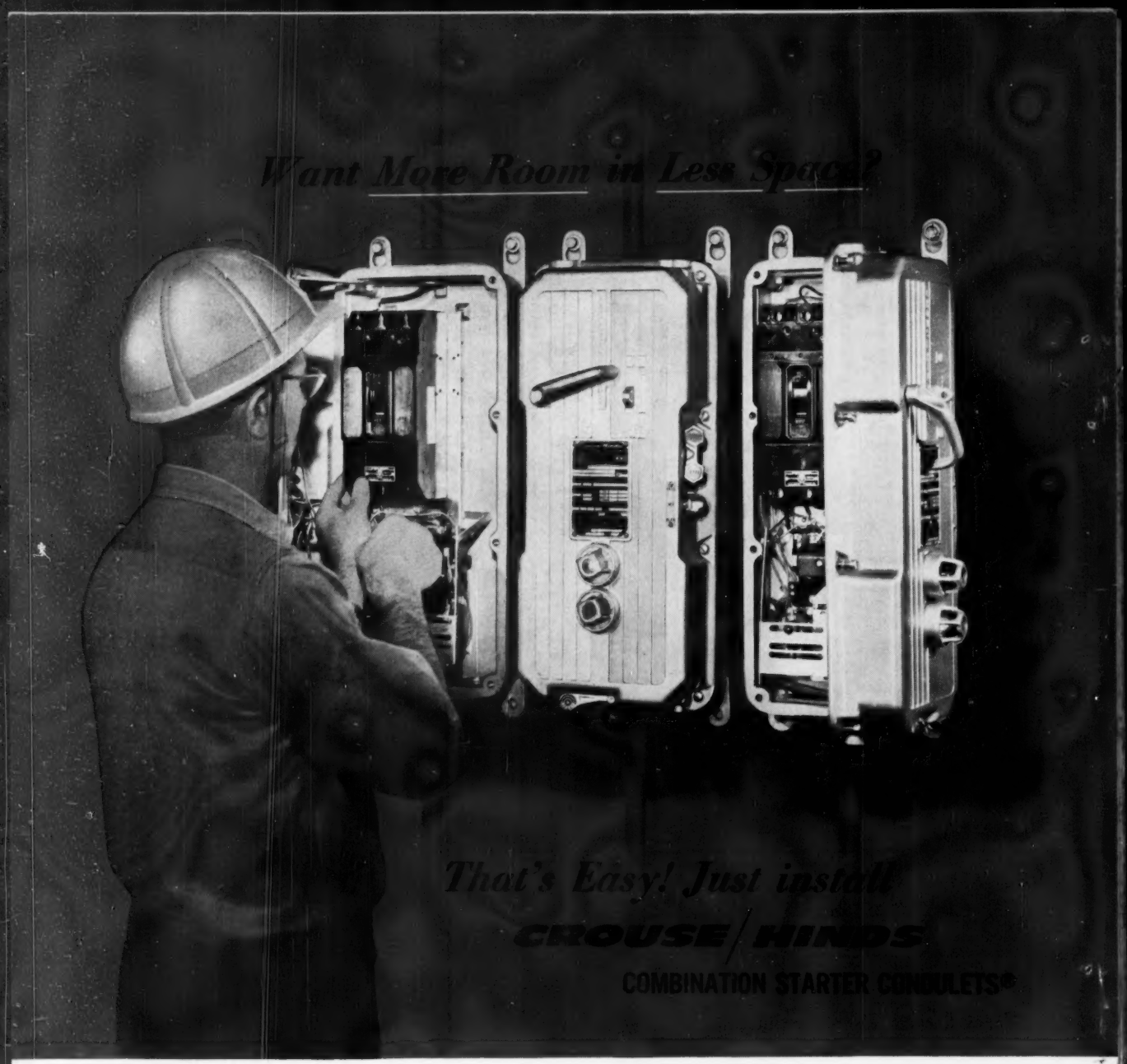
NEMA TYPE 1 ENCLOSURE ALSO AVAILABLE

NEMA Type 1 enclosures, offered in Sizes 0 through 4, can be modified by addition of a pushbutton, selector switch or other accessories. Easy-to-use kits simplify field installation.

Write for Bulletin SM-292. Address Square D Company, Dept. SA, 4041 North Richards Street, Milwaukee 12, Wis.

SQUARE D COMPANY

wherever electricity is distributed and controlled



Sure, they'll take any-make starter or circuit breaker. The door swings open right or left. Doesn't make any difference which. You always have plenty of room to work. And plenty of future capacity, too. Crouse-Hinds DMC/WMC's can be had with pilot-light holes, push-button holes, or selector-switch operating-shaft holes already drilled, tapped and plugged. Installation is always simple, fast, permanent. Dismounting just as easy, should you need to move to a new location.

Plenty of other advantages make for ease, endurance and economy. For example: Both the dust-ignition-proof DMC and the watertight WMC are strong, lightweight and corrosion resistant, made from top-quality *cast* aluminum. Each is designed for flexibility and for low-cost installation.

Ask your Crouse-Hinds Distributor for details. You can't go wrong. The dust-ignition-proof DMC conforms to National Electric Code Class II, Groups E, F, G and NEMA Type 9 EFG. While the watertight WMC conforms to NEMA Types 3, 3R, 4 and 5.

CROUSE/HINDS
SYRACUSE / NEW YORK

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